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OSTEOLOGY FOR STUDENTS

NORTON

SECOND EDITION

OSTEOLOGY:

A CONCISE

DESCRIPTION OF THE HUMAN SKELETON,

ADAPTED FOR

THE USE OF STUDENTS IN MEDICINE,

Accompanied by an Explanatory Atlas of Plates.

BY

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SECOND EDITION.

LONDON:
BAILLIERE, TINDALL, & COX,
20, KING WILLIAM STREET, STRAND, W.C.
1874.

LONDON:
HARRISON AND SONS, PRINTERS IN ORDINARY TO HER MAJESTY,
ST. MARTIN'S LANE.

PREFACE.

OSTEOLOGY is the basis of Anatomy. Upon the skeleton, as upon a framework, the softer tissues are attached and superimposed; therefore, without a knowledge of the former it becomes impossible to comprehend the latter. Nevertheless the student often delays for a considerable period the study of that portion of Anatomy, the knowledge of which when achieved, renders the whole comparatively easy. The reason of this is that Osteology is difficult of comprehension, it being rare to find a bone perfect in all its points; and, furthermore, it is a subject to be retained by the memory alone, unassisted by calculation, few characters only of a bone being due to or dependent upon others. To this may be added, that Osteology is a branch of science entirely new to the student, totally distinct from the ordinary course of education, and the first of a difficult series of subjects which opens upon the pupil at the commencement of his Hospital career.

For the study of the Bones numerous works have been published from time to time, and latterly they have been simplified by the introduction of explanatory Plates. But in the small volume now before the student, the author has endeavoured to omit all extraneous matter, and at the same time, by a brief yet pointed description, to free the subject of the inattractive character so frequently complained of by the beginner. The plates have been arranged in the form of an atlas, and it may be observed that a vast amount of care has been bestowed upon these plates by the artist, Mr. Sherard

Coleman, under the constant superintendence of the author, in order to produce as closely as possible the effect of a well marked and solid bone, in place of the simple outline more generally adopted.

The ossification of the skeleton is a branch so distinct from descriptive anatomy, that the author has preferred to place that portion of the subject in a separate chapter, giving the student the opportunity of making himself acquainted with the formation of the bones either individually or collectively.

The author, when a student, learned Osteology from that excellent and original work by Ward, and in some few instances has carried out the method of description adopted by him.

In the second edition, the numbers which indicate on the plates the attachment of muscles or other important parts of the bone are appended to the letter-press, so that the reader, whilst studying the letter-press, can refer to the plate without searching for the number in the plate-explanation.

The chapter on Ossification is much lengthened, so that the work now contains probably all that is known upon the subject.

In the first edition, the author referred to the difficulty attached to the investigation of the ossification of human bones. Since that time he has made very numerous dissections of fœtal bones of different ages, but withal he has found it necessary to refer frequently to the works of foreign writers, and among English works, to Quain's Anatomy, by Sharpey and Ellis.

6, *Wimpole Street, W.*

OSTEOLOGY.

In describing the human skeleton, it matters but little what method is adopted, so long as every point and distinctive character are brought fully into notice. At the same time, it is advisable that anatomists should be guided by some few rules, in order to prevent the confusion which might be otherwise produced.

In speaking of a surface or other characteristic point being external or internal, it must be understood to mean in reference to the median line of the body, and not to the median line of the part described.

With regard to osteological nomenclature, comparatively few names occur but what, if not familiar, are at least comprehensible. In studying this work, the student is advised always to have the bone as well as the plate before him, and, in following the letter-press, to place the bone in its exact position with regard to his own body, the correctness of which may be ascertained by reference to the plate. The use of the plates without the bones cannot be too strongly denounced.

The skeleton consists of a central trunk, the spinal column, supporting the skull at its upper extremity, and having connected with it anteriorly two spacious cavities, the thorax and pelvis, for the protection of the organs of functional life. Connected with the cavities are two pairs of limbs, the upper and lower extremities, or organs of prehension and progression. These several parts will be described in the following order:—

The Spinal Column.
The Thorax.
The Upper Extremity.
The Pelvis.
The Lower Extremity.
The Skull (Head and Face).

The skull, as being most complex, is given last, when the study of this part is rendered less difficult by the previous introduction to the subject; but it will be found better to follow the arrangement adopted in the course of lectures.

THE SPINAL OR VERTEBRAL COLUMN. (*Plate* I.)

The vertebral column, exclusive of the sacrum, is made up of twenty-four segments or vertebræ, arranged one above the other, for the purpose of forming a support for the limbs, and an osseous protection to the spinal cord and main trunks of blood-vessels. It is not straight but is curved forwards in the cervical and lumbar regions, backwards in the dorsal region by which means the cavity of the thorax is enlarged, and at the same time any severe impulse communicated to the buttock is materially decreased before arriving at the base of the skull. In consequence of these curves the bodies of the vertebræ become longer from above downwards either on the anterior or posterior surface according to the region.

The bodies of the vertebræ are separated from each other by an intervertebral substance or fibro-cartilage which further serves to break any force communicated, and which being somewhat flattened by compression during the erect position accounts for the fact that man is somewhat shorter at night than in the morning.

The segments of the column receive the name of the several regions they occupy—Cervical, Dorsal and Lumbar—and present somewhat different characters, first with regard to each separate set, and secondly with regard to individuality, although all may be to a great extent comprised in one general description.

Every vertebra possesses a large mass or body,[1] from which pass backwards two pedicles,[2] each to support one transverse[4] and two articular[6] processes. From these are continued, in a direction backwards and approaching each other, two thin plates of bone, the laminæ,[7] by the union of which posteriorly are produced a strong process, the spine,[8] and an arch which, with the body, encloses a central aperture, the vertebral foramen.[9]

The *body*[1] is flattened upon its upper and lower surface, where, by the intervention of a fibro-cartilage, it articulates with adjacent vertebræ, whilst its circular borders are prominent and attach in front the anterior common ligament. By this means the anterior surface of the body is rendered concave from above downwards, but is convex from side to side. The posterior surface of the body is, on the contrary, much flattened, or slightly concave from side to side, assists in forming the vertebral foramen, and is marked by large vascular foramina, for the supply of the cancellous mass.

The *pedicles*[2] are simply narrow processes extending backwards, and, by their sudden diminution in size as compared with the bodies, they produce above and below the vertebral notches which form with those of the vertebræ next in order the intervertebral foramina[3] for the transmission of the spinal nerves.

The *articular processes*[6] are four in number, a superior and inferior on each side. They articulate with the vertebra above and below, they look in different directions according to their region, and they possess a special capsular ligament.

The *transverse processes*[4] project laterally, and give attachment to muscles and intertransverse ligaments.

The *laminæ*[7] are thin plates, imbricating somewhat over the laminæ of the vertebra below. They support the spine posteriorly, and by their upper and lower borders attach the ligamenta subflava.

The *spine*[8] projects posteriorly, and is the perceptible part of the column. It gives attachment to numerous muscles, and also to interspinous and supraspinous ligaments.

The *vertebral foramen*[9] is the space contained within these bony structures.

THE CERVICAL VERTEBRÆ (*Plate* I.)

are the first seven segments of the column, from the head downwards.

The body[1] is small; longer from side to side than from before backwards, and slightly longer from above downwards in front than behind; convex upon its under surface; and concave upon its upper, which, at each lateral extremity, presents a prominent ridge for the more perfect reception of the body of the vertebra above.

The pedicles[2] differ greatly in this region in consequence of the peculiar attachment of the transverse process by two roots. They pass considerably outwards as well as backwards.

The transverse processes[4] are attached by two roots, enclosing between them a circular foramen[5] for the transmission of the vertebral vessels. They run outwards and slightly downwards, and are bifurcated at the extremity.

The articular processes[6] are much flattened, the two superior looking backwards and upwards, the two inferior forwards and downwards.

The laminæ[7] are very long, thin and narrow from above downwards.

The spine[8] projects somewhat downwards, and beneath its extremity becomes bifurcated.

The vertebral foramen[9] is heart-shaped and very large.

Of the seven cervical vertebræ three may be recognized from the rest, the first, second, and seventh.

The *first cervical* vertebra, called the atlas, possesses no body and but a rudimentary spine. It is composed of two lateral masses, from which the transverse processes proceed, and of an anterior and posterior arch. The anterior arch[10] is a thin plate, convex in front, but excavated posteriorly for articulation with the odontoid process of the second vertebra.

The lateral masses are composed of the articular and transverse processes. The superior articular processes are long, concave, nearer to each other in front than behind, and look upwards, inwards and backwards. The inferior articular processes are circular and flat, are placed immediately beneath the superior processes, and look downwards and inwards.

The transverse processes arise from the outer surface of the lateral mass by two roots containing between them the foramen for the vertebral vessels. They are truncated at the extremity, and there give origin to the superior oblique muscles and insertion to the inferior oblique. On the inner surface of each lateral mass, between the superior and inferior articular processes, is a rough depression,[11] sometimes a tubercle, for the attachment of the transverse portion of the crucial ligament which assists in holding the odontoid process in position.

The posterior arch completes the bone. It projects posteriorly in the form of a tubercle or rudimentary spine[12] for the origin of the two rectus capitis posticus minor muscles, and is smooth on its anterior surface where it bounds the spinal foramen. Upon its superior margin under cover of the superior articular process, is a groove[13] continuous with the vertebral canal: it transmits the vertebral artery into the skull, and the first cervical nerve out of the skull.

The *second cervical* vertebra is termed the axis, since it is on this bone that rotation of the head takes place.

The body, on its anterior surface, presents a longitudinal line separating two rough depressions, into which are inserted the longus colli muscles: posteriorly it is flat and much perforated, and inferiorly assumes the characters common to the cervical vertebræ: superiorly the odontoid process,[14] a club-shaped mass, ascends to take the place of the body of the atlas.

This process is smooth in front for articulation with the anterior arch of the atlas, and smooth behind from contact with the traverse ligament, but at its apex it is rough for the attachment of the odontoid or check ligaments.

On each side of the base of the ȯdontoid process is the superior articular surface,[6] which is flat, nearly circular in form and directed upwards and outwards.

Beneath these the transverse processes[4] project outwards and downwards, being pointed and not bifurcated; whilst more posteriorly are the inferior articular surfaces, comparatively small, flat and circular, and directed downwards, forwards and slightly outwards. The notches,[8] the inferior of which are much the larger, lie in the line immediately between the superior and inferior articular processes. The laminæ[7] are very strong, and terminate in a large but short spine,[8] which is deeply grooved below, and which gives origin to the inferior oblique and rectus capitis posticus major muscles on each side of its extremity.

The *seventh cervical* vertebra approaches in characters those of the dorsal region, presenting a spine of greater length, more inclined downwards, and tuberculated instead of bifurcated for the attachment of the ligamentum nuchæ. The transverse processes also are not bifurcated, and are often deficient of the foramen for the vertebral artery.

THE DORSAL VERTEBRÆ. (*Plate* I.)

The dorsal vertebræ, twelve in number, correspond in position to the cavity of the thorax, and in consequence of a posterior curve of the spine in that region, their bodies are somewhat longer from above downwards behind than in front. The body is much larger than that of a cervical vertebra, more prominent or convex from side to side in front, and more concave behind. It presents on each side two half facets,[16] one at its upper and one at its lower border, for articulation each with one half of the head of a rib. The pedicles[2] are well defined, forming the intervertebral notch[3] in their lower part. The articular processes[6] are flattened; and of these the superior are directed backwards and outwards, whilst the inferior, which have a tendency to concavity, take an opposite direction. The transverse processes[4] are truncated externally: they pass obliquely outwards and backwards; and they present anteriorly a facet[17] for articulation with the tubercle of the corresponding rib. The laminæ[7] are broad, but do not extend far backwards. The spines[8] are long, tuberculated at the extremity and imbricate the upper over the lower. The spinal foramen[9] is nearly circular, and the smallest of the three regions.

Among the dorsal vertebræ, the first, ninth, tenth, eleventh, and twelfth, present sufficient differences to be distinguished from the rest and from each other.

The *first* has instead of the ordinary two half facets on each side the body an entire facet above and a demi-facet below. The body is also longer from side to side than from before backwards. The spine is nearly horizontal.

The *ninth* is deficient of its lower half facet, which is taken up by the tenth.

The *tenth* articulates with one entire rib, and therefore has one complete facet on each side. The *eleventh* and *twelfth* likewise possess one complete facet, but since they are connected with the two floating ribs there is no articular facet upon the transverse process. The inferior articular processes of the twelfth, exactly resemble those of a lumbar vertebra, being directed forwards and outwards.

THE LUMBAR VERTEBRÆ. (*Plate* I.)

The lumbar vertebræ are five in number, and extend from the level of the ribs to the level of the pelvis.

The body[1] is of large size and long in the transverse diameter: it is slightly longer from above downwards in front than behind, owing to the forward curve of the column. The pedicles[2] are large, with the notch[3] chiefly below. The transverse processes[4] are long, but flat and thin, being longest in the third and shortest in the fifth and first. The articular processes[6] are strong and massive, the superior being concave and directed inwards and slightly backwards; the inferior convex and in the opposite direction. The laminæ[7] are thick, but short. The spine[8] is heavy and horizontal, and enlarges at its extremity in a downward direction, but is not tuberculated. The spinal foramen[9] is large and of a triangular form.

The *fifth lumbar* vertebra differs from the rest, in that the body is considerably longer from above downwards in front than behind; in that its transverse processes are short, pointed, and irregular for the attachment of sacro lumbar and ilio lumbar ligaments; and in that its inferior articular processes are widely separated for articulation with the sacrum.

THE BONES CONSTITUTING THE THORAX.

THE RIBS. (*Plate* II.)

The ribs, twenty-four in number, twelve on each side, surround the cavity of the thorax, and correspond to the twelve dorsal vertebræ, with which they articulate posteriorly. The upper seven are connected with the sternum in front, by means of costal cartilages, and receive the name of the true ribs: the remaining five are called false, and of these the first three are connected by their cartilages each with the one above, the last two are free at their anterior extremities, and are termed the *floating* ribs.

A *rib* is a long bone with two extremities, much curved and flattened laterally, so as to present an external and an internal surface, a superior and inferior border.

The posterior extremity or *head*[1] of the rib articulates with two dorsal vertebræ by two facets, separated from each other by a horizontal ridge, which gives attachment to the interarticular ligament. Upon the anterior surface of the head the stellate ligament is attached. From the head the rib is directed outwards and backwards, and is at first somewhat constricted to form the *neck*.[2] Here two ligaments are attached, the anterior costo-transverse to its upper border, the middle costo-transverse to its posterior surface. More externally the rib enlarges into a *tubercle*,[3] part of which in the form of a facet articulates with the transverse process of the lower of the two vertebræ with which the head is connected, whilst the rest is rough for the attachment of the posterior costo-transverse ligament.

The remainder of the rib may be termed the *shaft,* and upon the outer surface of this, at a distance from the tubercle varying with the numerical position of the rib, an oblique line extends from its upper to its lower border forwards and downwards; and beyond this point the bone markedly curves forwards, producing what is termed the angle.[4] Between the tubercle and the angle the erector spinæ muscles take attachment, and in front of the angle other muscles, differing according to the position of the rib. The inner surface is smooth, and along it, near the lower border, a groove[5] courses from behind forwards.

The edges of this groove, one of which is the sharp inferior border of the rib, give attachment to the external and internal intercostal muscles. The superior border[6] of the rib is rounded and attaches both layers of intercostal muscles. The anterior extremity[7] is cup-shaped to receive its costal cartilage.

Of the twelve ribs the seventh is the longest, and from this they decrease, both above and below. When well marked the first, second, tenth, eleventh, and twelfth, are distinguishable from the rest.

The *first rib* is extremely short, and is flattened so that its surfaces become superior and inferior, and its borders external and internal. The head[1] is small and has but one facet, which articulates with the first dorsal vertebra; the tubercle[3] is prominent, and the rib possesses no angle. The upper surface gives origin to the scalenus medius muscle by a depression[4] running from the tubercle forwards; and at its anterior third presents a more or less defined line, commencing internally by a fine tubercle[5] and running forwards and outwards, for the origin of the scalenus anticus. Posterior to this line the subclavian artery is in contact with the rib, and anterior to it the subclavian vein. The subclavius muscle[7] also arises from this surface at the junction of the rib with its cartilage. The inferior surface does not possess the usual groove; and the anterior extremity is very much thickened and generally incorporated with the sternum.

The *second* rib verges into the ordinary characters of a rib. Its surfaces are very oblique in position, one looking outwards and upwards, the other in the opposite direction; the former is strongly marked by the origin of the serratus magnus muscle, and behind this by the origin of the scalenus posticus muscle.

The *tenth* rib articulates with one vertebra only, and therefore possesses but one facet upon the head.

The *eleventh* and *twelfth*, or floating ribs, have each but one facet upon the head for articulation with one vertebra, and since they are not connected with the transverse processes, they possess no tubercle: further than this, the angles are but very imperfectly if at all marked, and the grooves on the inner surface are absent.

THE COSTAL CARTILAGES. (*Plate* II.)

The costal cartilages are prolongations of the ribs forwards, and serve to connect the upper seven with the sternum, as well as to give elasticity to the entire thorax.

The cartilage, at its costal extremity, fits into a cup-shaped depression in the sternal extremity of the rib; the periosteum and the perichondrium becoming continuous. The cartilage of the first rib is united with the sternum: those of the second, third, fourth, fifth, sixth, and seventh articulate with depressions formed in the margins of the sternum, the joints being lined by a synovial membrane, and strengthened by anterior and posterior ligaments: those of the eighth, ninth, and tenth ascend to be lost each in the one next above: and those of the eleventh and twelfth are short, unattached, and floating.

The surfaces of the costal cartilages are anterior and posterior, the former being somewhat convex, and the latter somewhat concave for the thoracic cavity.

The borders, superior and inferior, are continuous with those of the ribs.

THE STERNUM. (*Plate* III.)

The sternum is a flattened bone, occupying the median line of the anterior wall of the thorax. It is composed of five pieces, the lower four of which are always united together and tipped below by a process of cartilage. From the resemblance of the whole to a sword, the first piece, which is almost invariably separate from the rest, has received the name of the manubrium; the four pieces united are called the gladiolus; and the apex the xyphoid or ensiform cartilage.

The *manubrium* is quadrilateral; broader above than below; convex upon its anterior surface, where it gives origin to the sterno mastoid[1] muscles above, and to the aponeurosis of the pectoralis major[2] muscle below; and concave upon its posterior surface, where the sterno hyoid[3] and sterno thyroid[4] muscles arise. The superior border is thick, and marked by two large concavo convex facets,[5] for articulation with the clavicles. In front and behind these the anterior and posterior sterno clavicular ligaments are attached, and between them is a smooth portion, the interclavicular notch,[6] for the reception of the trachea in extreme flexion of the head. The inferior border is in contact with the gladiolus, but is not usually attached, and at each extremity it articulates with a portion of the second costal cartilage by means of a half facet.[7] The lateral borders are rough and irregular where the first rib[8] is attached, and at their lower extremity they exhibit the half facet for the second rib mentioned on the lower border.

The *gladiolus* is long, flat, wider below than above, and marked upon its anterior surface, which can be distinctly felt beneath the integument, by three transverse lines, the original separation of the bone into four. From this surface the aponeuroses of the two pectoralis major muscles arise. The posterior surface also shews the same transverse lines, and at the lower part gives origin to the triangularis sterni[9] muscles. The lateral borders present a facet for articulation with the costal cartilage, stituated at the extremity of each transverse line, but towards the lower part of the border the distance between the facets decreases, and often the sixth and seventh costal cartilage together articulate with that facet which is formed by the union of the xyphoid cartilage with the sternum. The upper border of the gladiolus is in contact with the manubrium, and is in old age sometimes connected with it by ossification. The lower is connected with the xyphoid cartilage.

The *xyphoid* or *ensiform* cartilage is an appendix of an irregularly triangular form, attached by its base to the sternum, and by its apex to the linea alba; and presenting laterally a half facet for articulation with the seventh costal cartilage. From its posterior surface fibres of the diaphragm[10] and triangularis sterni[9] muscles take origin. It is often perforate in its centre.

THORAX. (*Plate* II.)

The dorsal vertebræ in the median line posteriorly, the sternum in the median line anteriorly, and the ribs and their cartilages laterally, together enclose a conical space, with the base downwards, termed the thorax.

The object of this osseous arrangement is the protection of organs of vital importance, the heart and lungs, as well as to enable the action of respiration to be carried on by means of the alteration in position of the bones, and consequent increase and decrease of the contained cavity. The thorax possesses an aperture at the apex for the transmission of structures to and from the neck, bounded by the first rib on each side, the body of the first dorsal vertebra behind, and the superior margin of the sternum in front. It possesses also an aperture at the base of very much larger dimensions, which is bounded by the ensiform cartilage, the seventh, eighth, ninth, tenth, and the extremities of the eleventh and twelfth costal cartilages, the last rib, and the twelfth dorsal vertebra. This space is occupied by the diaphragm in the recent subject, and transmits numerous structures to and from the abdomen.

When viewed from without as a whole, the chest appears convex in every direction, although it is somewhat more flattened in front, where it is formed by the sternum and costal cartilages, than in other parts. Posteriorly, the spines of the dorsal vertebræ, overlapping each other, project as a prominent ridge, and on each side between the spines and the transverse processes is a considerable space occupied by the erector spinæ muscles, and described as the posterior vertebral groove. Laterally, the chest presents only the ribs running forwards and downwards, and separated from each other by intervals, the intercostal spaces.

Viewed from within, the cavity appears flattened anteriorly, where it is bounded by the posterior surface of the sternum and costal cartilages; convex posteriorly in the median line where the bodies of the dorsal vertebræ project forwards, but on each side of these concave, where the ribs curve backwards to form what is frequently called the anterior vertebral groove; and lastly, markedly concave laterally where it is bounded by the concave surfaces of the shafts of the ribs.

During inspiration the thorax increases in size both from before backwards and from side to side, the former in consequence of the elevation of the anterior extremity of the rib and the latter in consequence of the elevation of the angle of the rib which it must be remembered extends some considerable distance outwards and downwards from the column.

The depth of the thorax is also increased by the contraction or descent of the diaphragm.

The expansion of the thorax is necessarily accompanied by the inhalation of air which rushes into the lungs to occupy the increased space.

THE UPPER EXTREMITY.

THE CLAVICLE. (*Plate* III.)

The clavicle is a much curved bone, horizontal in position, and articulated internally with the sternum, and externally with the acromion process of the scapula, for the purpose of retaining that bone and the upper limb extended from the body.

Near the sternum the bone is thick, solid, and angular, but as it approaches the scapula it becomes flattened and thin. On this account the shaft may be conveniently divided into a *sternal half* and an *acromial half.*

The internal or sternal extremity articulates with the sternum by means of a large triangular facet,[1] which is concave from before backwards, and convex from above downwards. It is directed inwards and downwards and projects downwards and backwards behind the corresponding facet of the sternum. The borders of this facet give attachment to the anterior, posterior, and superior or interclavicular ligaments respectively, and the joint is one of the few that possess an interarticular fibro-cartilage. The external or acromial extremity articulates with the acromion process of the scapula by means of a small oval facet,[2] directed forwards, downwards and outwards; and to its borders are attached superior and inferior acromio clavicular ligaments.

The shaft of the bone is curved forwards at the *sternal* half, where it cannot be said to possess surfaces distinguishable in all bones. This part may be distinctly felt beneath the integument, and it gives origin to the sterno cleido[3] mastoid muscle, by a marking about two inches in length along its superior aspect commencing at the sterno-clavicular articulation; and to the clavicular portion of the pectoralis major[4] muscle by a marking on its anterior aspect nearly a half the length of the bone. The inferior aspect, which in size more nearly approaches to a border, presents a rough and strongly marked impression for the attachment of the costo-clavicular[5] ligament.

The *acromial* half of the shaft is flattened, and curves backwards so as to become concave upon its anterior margin. Its superior surface is somewhat rough, and covered by a tendinous communication between the trapezius and deltoid muscles. Its inferior surface presents a groove,[6] in the depths of which is attached the subclavius muscle, and to whose borders is fixed the costo-coracoid ligament. Within it also the nutrient foramen is usually to be found. More externally upon this surface is a small tubercle,[7] and from it a line[8] is continued outwards, for the attachment of the coraco-clavicular or conoid and trapezoid ligaments.

The anterior margin is concave and rough for the origin of the deltoid muscle.[9] The posterior margin is convex, and receives the insertion of the trapezius.[10]

THE SCAPULA. (*Plate* III.)

The scapula is a flat bone of triangular form, lying upon the posterior part of the thorax, and connecting the upper extremity to the trunk. It presents two surfaces, two processes, and three borders, the last of which by their union form three angles.

The *anterior surface*[1], or venter of the scapula, consists of a deep fossa for the origin of the subscapularis muscle, and is marked by horizontal lines, which attach tendinous intersections of the same muscle. Along its posterior portion, but more defined near the upper and lower angles, is a flattened surface for the insertion of the serratus magnus[2] muscle. The posterior surface or dorsum is chiefly convex, and is divided by a projection termed the spine into two unequal parts, the upper of which, one-third the size of the lower, bears the name of the supraspinous fossa,[3] and gives origin to the supraspinous muscle, whilst the lower or infraspinous fossa[4] gives origin to the infraspinous muscle. On this portion of the bone may be seen a line in close proximity to the outer border, separating a narrow surface which gradually widens as it descends towards the inferior angle, where it becomes divided into two parts, an upper and longer for the origin of the teres minor muscle,[5] and a lower and broader for the origin of the teres major.[6]

The spine commences from the posterior border by a small triangular surface, from which it increases in size as it extends outwards, and finally terminates by flattening in a contrary direction, where it receives the name of acromion process.[7] Its upper and lower surfaces assist in forming the supra and infraspinous fossæ respectively, and give origin to fibres of the muscles which arise within them. Its free posterior border or crest overlaps at its edges, above for the insertion of the trapezius,[8] and below for the origin of the deltoid,[8] whilst the intermediate portion is subcutaneous. Its external border[10] is smooth, rounded, and free, and assists in forming a groove, known by the name of the neck, which transmits suprascapular vessels and nerves from the upper into the lower fossa. Its anterior or attached border is the part by which it arises from the posterior surface of the scapula.

The *acromion process* is a continuation of the crest of the spine outwards and forwards, its borders corresponding to the upper and lower lips, and its upper surface to the subcutaneous interval between them. It courses at first in the same direction as the spine, and then turns forwards and upwards to overlap the shoulder joint. By its anterior border, similar to the upper lip of the spine, it gives insertion to the trapezius,[8] and articulates with the clavicle by means of an oval facet,[11] which looks inwards and upwards; and by its posterior border, which, in turning, becomes external, it gives origin to the deltoid.[9] Its upper surface is rough and subcutaneous, and its lower overlaps the joint, whilst the apex attaches the coraco-acromial ligament.

The borders of the scapula are superior;[12] external[13] or axillary; and internal,[14] vertebral, or base.

The *superior* border,[12] the shortest of the three, presents externally a notch,[15] which, when converted into a foramen by the suprascapular ligament, transmits the suprascapular nerve, whilst the ligament itself is crossed by the artery, and gives origin, together with a portion of the superior border, to the omo-hyoid muscle.[16] The *external* border is the strongest and stoutest of the three, and, by an impression below the head of the bone, an inch and a half in length, gives attachment to the tendinous origin of the long head of the triceps muscle:[17] from this part it gradually lessens in width towards the inferior angle. The *internal* border runs nearly parallel with the vertebral column, and by that portion above the level of the spine of the scapula gives insertion to the levator anguli scapulæ.[18] At the level of the spine, it gives origin to the rhomboideus minor,[19] and between the spine and the inferior angle to the rhomboideus major;[20] whilst into its anterior lip or margin in its whole extent, the serratus magnus is inserted and into the posterior some few fibres of the supra and infra-spinous muscles. The *superior angle*[21] is very thin, and separates the superior from the internal border. The *inferior angle*[22] separates the internal from the external border, and to it properly belongs the triangular surface for the origin of the teres major muscle. Fibres of the latissimus dorsi also often arise from this point. The *external angle*,[23] situated at the junction of the superior and external border, is rightly termed the head of the scapula. It presents a large pear-shaped facet,[24] with the apex upwards, described as the glenoid cavity, for articulation with the head of the humerus. This cavity is surrounded by the capsular ligament of the joint, and is deepened by the glenoid ligament, a fibrous mass encircling the edges and becoming continuous at the apex of the cavity with the long head of the biceps muscle,[25] which may therefore be said to take origin from it. Immediately behind the head is the contracted portion or neck[10] already mentioned as being partly formed by the external border of the spine. Commencing from the head and superior border is the *coracoid* process,[26] which, projecting at first upwards and slightly inwards, afterwards turns forwards and outwards to overlap the joint. Upon its upper surface is a roughened portion for the attachment of the coraco-clavicular ligaments;[27] by its anterior border it gives insertion to the pectoralis minor muscle;[28] at its posterior border is attached the coraco-acromial ligament;[29] and from the apex two muscles,[30] the coraco brachialis and short head of the biceps, arise together.

THE HUMERUS. (*Plate* IV.)

The humerus is the longest and largest bone of the arm, and consists of a shaft with an upper and lower extremity.

The *upper extremity* articulates with the glenoid cavity of the scapula by a rounded head,[1] the articulating surface of which is directed inwards, upwards, and backwards, and is encircled by a roughened groove described as the anatomical neck,[2] which marks the extent of the articular cartilage, and gives attachment to the capsular ligament. External and inferior to the anatomical neck, the upper extremity presents two tuberosities, the external[3] and the internal,[4] according to their position, separated from each other by a deep longitudinal groove.[5]

The *internal tuberosity*[4] is the smaller of the two, but is more defined, and receives the insertion of the subscapularis muscle. The *external*[3] occupies the whole of the outer part of the extremity, and receives the insertion of three muscles, namely, from before backwards, the supraspinous, infraspinous and teres minor; whilst the separating groove[5] conveys the tendon of the longhead of the biceps muscle downwards from the joint, and a small articular artery upwards to the joint.

The *shaft* of the bone is somewhat contracted a little below the tuberosities, and from the liability to fracture at this point, it has been called the surgical neck.[6] At the lower half the shaft becomes markedly triangular, but throughout it may be said to be divided by three lines or borders into as many surfaces.

The *anterior border* forms above the outer ridge of the bicipital groove,[5] where it receives the insertion of the pectoralis major muscle; below this it occupies the median line of the bone, being under cover of the brachialis anticus[7] muscle; and it terminates by dividing into two diverging portions which contain between them a depression, the coronoid fossa,[20] for the reception of the coronoid process of the ulna in extreme flexion.

The *internal border* forms above the inner ridge of the bicipital groove where it receives the insertion of the teres major and latissimus dorsi muscles, and terminates below in the prominence of the internal condyle, above which for a short distance it is called the internal condyloid ridge.[8]

The *external border* extends from the posterior part of the great tuberosity downwards to the prominence of the external condyle. In its whole extent fibres of the triceps muscle arise from it posteriorly; whilst from the lower fourth, which is strongly marked, and termed the external condyloid ridge,[9] arise two muscles, the supinator radii longus, from about two inches, and below it the extensor carpi radialis longior.

The *internal surface* is the space between the anterior and internal borders, forming in its upper fourth the bicipital groove. Below this it widens considerably and presents a more or less roughened portion for the insertion of the coraco brachialis,[10] whilst the rest of its extent gives origin to the brachialis anticus muscle.[7]

The *external surface* lies between the anterior and external borders. It presents a well-defined rough impression in its middle third for the insertion of the deltoid muscle,[11] and below this, though comparatively smooth, gives origin to the brachialis anticus.[7]

The *posterior surface* lies between the external and the internal borders. It is covered by the triceps muscle, the external head[13] of which arises as high up as the insertion of the teres minor on the great tuberosity, and the internal head[14] as high as the insertion of the teres major. On the internal border, crossing from within outwards and very obliquely downwards across the posterior surface, is a more or less marked groove[15] formed by the musculo spiral nerve.

The *inferior extremity* of the humerus projects laterally in the form of two prominences, the condyles. Of these the internal[16] is considerably the larger, and gives origin by a common tendon to the pronator radii teres, flexor carpi radialis, palmaris longus, flexor sublimis digitorum, and flexor carpi ulnaris muscles, as well as to the internal lateral ligament of the elbow-joint. The external condyle[17] is smaller and more flattened, and gives origin to the extensor carpi radialis brevior, extensor communis digitorum, extensor minimi digiti, extensor carpi ulnaris and anconeus muscles, and to the external lateral ligament of the elbow-joint. The inferior extremity of the humerus terminates in an irregular articular surface, for articulation with the radius and ulna, the innermost part descending some distance below the rest, so that the arm in flexion is thrown across the chest. The external portion of this surface is globular,[18] for articulation with the concavity upon the head of the radius, and is termed the capitellum; the remainder is called the trochlea,[19] and articulates with the greater sigmoid cavity of the ulna.

In front of the lower extremity, immediately above the trochlea, is a triangular depression termed the coronoid fossa,[20] for the reception of the coronoid process of the ulna in flexion; and external to it above the capitellum a small fossa,[21] into which the head of the radius passes when the forearm is flexed to the extreme. Behind the lower extremity a very considerable cavity of triangular form, the olecranon fossa,[22] receives the olecranon process of the ulna in extension, and so limits that motion. Above the fossæ which receive the processes of the ulna rise respectively the anterior and posterior ligaments of the elbow-joint.

THE RADIUS. (*Plate* IV.)

The radius is the external of the two bones of the forearm. It presents at its upper extremity a circular enlargement or head.[1] This portion is concave above for articulation with the capitellum of the humerus, smooth in its circumference for motion within the orbicular ligament, and prolonged downwards internally for adaptation to the lesser sigmoid cavity of the ulna.

The *head* is supported by a smooth and circular constriction or neck,[2] and is by it separated from a protuberance on the inner side of the bone, which, under the name of the tuberosity[3] of the radius, receives on its inferior and posterior portion the insertion of the tendon of the biceps muscle.

The *shaft* of the bone is somewhat curved outwards, and presents three borders separating three surfaces. On the side contiguous to the ulna is the sharp internal border,[4] along which is attached the interosseous membrane. This border extends from the tuberosity above downwards to the lower fifth of the bone, where, bifurcating, it encloses the sigmoid cavity or articular facet for the reception of the lower extremity of the ulna.

The *anterior border*[6] extends from the tuberosity[8] downwards, and at first obliquely outwards, to the anterior edge of of the styloid process.[15] By its upper portion, termed the oblique line[7] of the radius, it receives the insertion of the supinator radii brevis muscle, and gives origin to the flexor sublimis digitorum, whilst into its lower fourth is inserted the pronator quadratus.[8]

The *posterior border* is the most indefinite of the three, and may be said to extend from the neck above to the posterior edge of the styloid process below.

Of the surfaces of the shaft, three in number, the *anterior* lies between the internal and anterior borders. It is slightly hollowed in its upper two-thirds, where the flexor longus pollicis[9] arises, and is flattened in its lower fourth, where the pronator quadratus[8] is inserted. The nutrient artery enters about the uppermost part of this surface and passes upwards.

The *posterior surface* lies between the internal and posterior borders. It presents above a smooth portion extending round towards the oblique line for the insertion of the supinator radii brevis,[10] and below this a rough flattened portion, extending slightly below the centre of the shaft, for the origin of the extensor ossis metacarpi pollicis[11] and extensor primi internodii pollicis.[12]

The *external surface* lies between the anterior and posterior borders: and it presents about its centre a rough impression for the insertion of the pronator radii teres,[13] and above this a smooth surface of considerable extent for the insertion of the supinator radii brevis.[10] The lower part is smooth for the passage of tendons.

The *inferior extremity* of the radius presents a terminal or carpal articular surface[14] of triangular form, whose apex is directed outwards, and which is divided by an antero posterior ridge into two parts, an external triangular for articulation with the scaphoid bone, an internal quadrilateral for articulation with the semilunar bone.

The internal aspect of the extremity exhibits the sigmoid cavity,[5] or facet for articulation with the lower extremity of the ulna already mentioned as contained in the bifurcation of the internal border of the radius.

The external aspect is formed partly by a process termed the styloid process,[15] projecting almost perpendicularly downwards, into the base of which the supinator radii longus[16] is inserted, and into whose apex the external lateral ligament of the wrist-joint is attached. The process is traversed by a perpendicular groove[17] for the transmission of the tendons of the extensor ossis metacarpi pollicis and extensor primi internodii pollicis muscles.

The anterior aspect is simply a continuation of the anterior surface of the shaft and receives the insertion of the pronator quadratus: along its lower margin is attached the anterior ligament of the wrist-joint.

The posterior aspect presents a central tubercle, around the inner side of which curves a small groove for the tendon of the extensor secundi internodii pollicis.[18] Internal to this groove is a second,[19] for the tendons of the extensor communis digitorum and extensor indicis; and external to it a third,[20] for the tendons of the extensor carpi radialis longior and extensor carpi radialis brevior. The lower margin of this aspect gives attachment to the posterior ligament of the wrist-joint.

THE ULNA. (*Plate* IV.)

The ulna is the companion of the radius, and the inner bone of the fore-arm.

Its *upper extremity* may be said to consist of two processes, a posterior, or *olecranon*,[1] and an anterior, or *coronoid*,[2] together forming a deep excavation under the name of the greater sigmoid cavity,[3] for articulation with the trochlear surface of the humerus.

The *olecranon* process[1] is the extreme portion of the bone, the subcutaneous prominence of the elbow-joint, and the limit to extension of the fore-arm. By its superior surface, which is quadrilateral, it gives insertion to the triceps muscle;[5] by its anterior surface it enters into the formation of the greater sigmoid cavity; and by the borders of the same it gives attachment to the posterior and external and internal lateral ligaments of the elbow-joint. The posterior surface is the part felt beneath the integument.

The *coronoid* process projects forwards and presents a superior surface, which forms the inferior portion of the greater sigmoid cavity; an anterior surface, which attaches the anterior ligament and gives insertion to the brachialis anticus muscle,[6] and which possesses at the lower part a tubercle[7] for the attachment of the oblique ligament of the elbow-joint; an internal surface,[8] somewhat hollowed, and giving origin to slips of the pronator radii teres and flexor sublimis digitorum muscles; and lastly, an external surface, upon which is situated an oval articular facet,[4] termed the lesser sigmoid cavity, and concave from before backwards for the rotating head of the radius. The flexor longus pollicis frequently takes origin by a fine slip of tendon from the external part of the coronoid process. The great sigmoid[3] cavity is the space formed by the two processes. It is concave from above downwards, but in its depths presents a central longitudinal elevation for adaptation to the trochlear surface of the humerus.

The shaft of the bone decreases in size from above downwards, and presents, like the radius, three borders separating three surfaces. On the radial side is the prominent sharp *external* border,[9] commencing above at the lesser sigmoid cavity, terminating below at the lower extremity of the ulna, and giving attachment in the greater part of its length to the interosseous membrane.

In front of the shaft the *anterior border* extends from the coronoid process above to the lower extremity of the ulna below. Its chief part is covered by the flexor profundus digitorum muscle,[10] but in the lower fourth it gives origin to the pronator quadratus.[11] Posteriorly an indistinct *posterior* border [12] extends from the olecranon to the styloid process,[20] and gives attachment to an aponeurosis common to the flexor profundus digitorum, flexor carpi ulnaris and extensor carpi ulnaris muscles.

Of the surfaces of the shaft, the *anterior* lies between the anterior and external borders. It is somewhat hollowed, presents the medullary foramen, and gives origin by its upper three-fourths to the flexor profundus digitorum,[10] and by its lower fourth to the pronator quadratus.[11] The *internal* surface lies between the anterior and posterior borders, and gives origin by its upper three-fourths to the flexor profundus digitorum,[10] and in the rest of its extent it is subcutaneous.

The *posterior* surface lies between the posterior and external borders, and it presents in the upper fourth a ridge running from the lesser sigmoid cavity downwards and inwards, thus cutting off a small fossa below the lesser cavity, from which the supinator radii brevis[13] muscle takes origin. On that portion of the surface above the ridge the anconeus[14] is inserted, and from that below it arise in order from above downwards the extensor ossis metacarpi pollicis,[15] occasionally extensor primi internodii pollicis[16](this latter generally does not arise from the ulna), extensor secundi internodii pollicis[17] and extensor indicis.[18]

The *lower extremity* of the ulna is very small when compared with the upper. It possesses an inferior surface,[19] separated from the carpus by the intervention of an interarticular fibro-cartilage; a smooth circumference, a large portion of which is covered with cartilage, and articulates with the sigmoid cavity of the radius; and at its inner and posterior part an elongated tubercle of bone, the styloid process,[20] which by its apex gives attachment to the internal lateral ligament of the wrist-joint and by its outer side to the interarticular fibro-cartilage. On the posterior aspect of the lower extremity is a longitudinal groove[21] for the transmission of the tendon of the extensor carpi ulnaris muscle.

THE CARPUS. (*Plates* V. *and* VI.)

The carpus is composed of eight bones, arranged in two rows. In the first row, from without inwards, are the Scaphoid, Semilunar, Cuneiform, and Pisiform bones; and in the second row, in the same order, the Trapezium, Trapezoid, Magnum, and Unciform. These bones are peculiar in possessing numerous articulating surfaces, and in always leaving an anterior or palmar, and a posterior or dorsal surface free for the attachment of ligaments. The dorsum of the hand is evidently more or less convex; while on the contrary the palm is to the same extent concave; and from this circumstance the dorsal ligamentous surfaces of the carpal bones are (with one exception) larger than the palmer. The semilunar bone differs from the rule in presenting its palmer larger than its dorsal surface.

THE SCAPHOID BONE.

The scaphoid bone may be described as presenting two surfaces; one convex, in position, posterior and external, the other concave, in position, anterior and internal. It is the outer bone of the first row, and is placed with its long diameter extending downwards and outwards, its larger extremity upwards, and its convex surface behind. The *convex surface* is divided into two parts by a groove, thus producing a portion[1] above irregularly triangular for articulation with the carpal surface of the inferior extremity of the radius, and a portion below for articulation chiefly with the trapezium,[2] but from which a small part more internal and farther from the groove is marked off for articulation with the trapezoid.[3] The groove[4] itself, which may receive the name of the posterior ligamentous surface, runs horizontally from before backwards, and gives attachment to ligamentous fibres.

The *concave surface* presents a large excavation[5] nearer its lower than its upper border, and of rounded form, to receive the head of the os magnum. Above this is a smooth flat semilunar facet[6] for articulation with the semilunar bone; whilst below, and anterior to it, is a rough irregular surface,[7] terminating anteriorly in a blunt tubercle, which is the anterior ligamentous surface,[7] and which gives attachment to the anterior annular ligament of the wrist-joint.

THE SEMILUNAR BONE.

The semilunar bone is the second of the first row. Somewhat of the form its name expresses, it presents six surfaces, and is, in all its characters, distinctly marked.

The *anterior*[1] and *posterior*[2] surfaces are rough for the attachment of palmar and dorsal ligaments; the posterior being usually much more rough and perforated than the anterior surface, which is the larger.

The *external* and *internal* surfaces are termed its semilunes, and of these the external[3] is smooth and finely crescentic for articulation with its equivalent on the scaphoid; the internal[4] is also smooth but more quadrilateral and articulates with the cuneiform bone.

The *superior* surface[5] is convex in every direction, smaller behind than in front, and smooth for articulation with the carpal surface of the inferior extremity of the radius.

The *inferior* surface[6] is deeply concave, and smooth for articulation with the head of the os magnum; but a small portion[7] at the innermost part of this surface is often separated off for articulation with the unciform bone.

THE CUNEIFORM BONE.

The cuneiform bone, the third of the first row, is of conical form, situated with its base uppermost and with its long diameter extending downwards and inwards.

It distinctly possesses three surfaces,—anterior, superior, and inferior,—and a base. The anterior surface is somewhat depressed[1] near the base where it is roughened for the attachment of the anterior ligament of the wrist-joint and for palmar ligaments, but near the apex it presents an oval convex facet[2] which articulates with the pisiform bone.

The *superior* surface enters into the formation of the wrist-joint by a quadrilateral smooth facet[3] near the base, which plays beneath the interarticular fibro-cartilage attached to the lower extremity of the ulna; whilst the remainder or internal part[4] approaching the apex is non-articular and roughened for the attachment of the internal lateral ligament of the wrist-joint.

The *inferior* surface is almost entirely articular. It possesses the largest facet[5] on the bone, and this is of quadrilateral form extending downwards and inwards so as to overlap and articulate with the unciform bone.

The *base*[6] looks almost directly outwards: it is articular, smooth, and of the same form as the internal surface of the semilunar bone with which it articulates, that is, approaching to a quadrilateral with the upper angles cut off.

THE PISIFORM BONE.

The pisiform bone is small compared with the rest of the carpal series. It is of rounded form, well described as pea-shaped, and lies upon the cuneiform as though secondary to it. It possesses one large articular facet[1] which occupies the whole of the posterior surface, and is oval and concave for articulation with a similar facet upon the anterior surface of the cuneiform bone, a synovial membrane, separate and special to this joint intervening. The bone is somewhat longer from side to side than from before backwards, and its external extremity[2] is considerably the larger, projecting over the carpus so as to partially overlap the ulnar vessels and nerves in their passage into the palm of the hand.

The *superior* surface[3] receives the insertion of the flexor carpi ulnaris muscle, and is decidedly convex, whilst the inferior[4] gives origin to the abductor minimi digiti, and has a tendency to overhang, thus producing a fine transverse groove which runs parallel with the border of the articular surface.

To recognize whether this bone belongs to the right or left hand is often very difficult, but when possible to determine the inferior surface it is much simplified, as the external extremity and the posterior articular facet are always tolerably distinct.

THE TRAPEZIUM.

The trapezium is the first bone of the second row, commencing from without. The *palmar* and *dorsal* surfaces are as usual both rough for the attachment of ligaments, and of these the palmar[1] surface presents a deep longitudinal groove[2] along which runs the tendon of the flexor carpi radialis muscle; whilst the prominent ridge[3] situated upon the outer side of the groove gives origin to muscles of the ball of the thumb, namely, fibres of the abductor pollicis, opponens pollicis, and the outer head of the flexor brevis pollicis, and also attaches the anterior annular ligament. The *dorsal* surface is larger than the palmar, and is rough and irregular for the attachment of the posterior carpal ligaments. The trapezium, when viewed from within, presents three articular facets, of which the middle[4] is the largest: this is concave, somewhat quadrilateral and articulates with the trapezoid. The superior[5] is next in size, directed upwards and inwards, more circular or semilunar in form and articulates with the scaphoid bone. The inferior[6] is the smallest, directed downwards and inwards, and articulates with the metacarpal bone of the index finger. When viewed from without the trapezium presents two surfaces, an inferior[7] which is larger, articular and of a saddle-shaped appearance for articulation with the metacarpal bone of the thumb; and a superior,[8] which is nonarticular, separated from the lower by a prominent ridge, and rough and irregular for the attachment of the external lateral ligament of the wrist-joint.

THE TRAPEZOID BONE.

The trapezoid bone is the second of the second row. It presents palmar[1] and dorsal[2] surfaces for the attachment of ligaments, but the rest of the bone is smooth for articulation.

The *palmar*[1] surface is somewhat quadrilateral, recedes at its external inferior angle, and gives origin to the inner head of the plexor brevis pollicis. The *dorsal* surface[2] is very much larger than the preceding, and is rough and irregular.

Around the bone may be distinguished four smooth surfaces for articulation. The largest of these, which may be called the *inferior*,[3] is saddle-shaped, that is, convex from side to side, slightly concave in the long diameter: it looks directly downwards and articulates with the metacarpal bone of the index finger. The surface, which may be called the *superior*,[4] is concave, looks directly upwards for articulation with the scaphoid, and is separated from the external surface only by a sharp border.

The *external* surface[5] is flattened, and looks outwards and upwards to articulate with the trapezium.

The *internal* surface[6] is long, narrow, and concave in its long diameter; and a large portion of it seems to be formed upon an inward projection of the bone near the dorsum. This surface articulates with the os magnum, and invariably presents about its centre a rough depression for an interosseous ligament between the two bones.

It is frequently difficult to distinguish the hand to which this bone belongs, but by attention to the above characters the internal, inferior, and palmar surfaces may be recognized and the bone determined.

THE MAGNUM BONE.

The os magnum is the third bone of the second row, and the largest in the carpus. It possesses a rounded head, occupying a large portion of a sphere, attached to the body by a contracted portion or neck, and adapted to a socket-joint formed by the scaphoid and semilunar bones.

The articular surface of the head is plainly divisible into two parts, of which the upper[1] is convex and quadrilateral, and articulates with the inferior surface of the semilunar bone. The lower[2] or external extends downwards upon the outer surface of the body of the bone; it is also convex, but of more circular form; and it articulates with the scaphoid bone.

On the body of the bone the *palmar* surface[3] is very prominent, except near the head, where it somewhat recedes; and it is usually perforated by the nutrient foramen. It gives origin to some fibres of the inner head of the flexor brevis pollicis. The *dorsal* surface[4] is broader, smoother, and somewhat excavated. The *external* surface[5] is largely occupied by the downward extension of the scaphoid facet of the head, but at the lower part a facet may be distinguished for articulation with the trapezoid bone; and this facet is marked by a depression for the interosseous ligament, and is by it frequently divided into two parts.

The *internal* surface[6] is almost entirely smooth, and articulates with the unciform bone. The *inferior* or metacarpal surface[7] looks directly downwards towards the metacarpal bones, with three of which it frequently articulates. It is concave from before backwards, and articulates chiefly with the third metacarpal bone, but on each side a narrow slip is cut off; the outer and larger for the second metacarpal bone, the inner and smaller for the fourth.

THE UNCIFORM BONE.

The unciform is the innermost bone of the second row, and receives its name from a hook-like process[1] springing from its palmar surface.

The palmar and dorsal surfaces must be first sought for, and of these the *palmar*[2] may be easily recognized by the unciform process[1] which is attached to its inferior and internal part. This process is flattened laterally, but is somewhat concave upon its outer surface, where it bounds a space through which the flexor tendons pass; and its apex gives attachment to the anterior annular ligament of the wrist-joint and origin to the flexor brevis minimi digiti and opponens minimi digiti.

The *dorsal* surface[3] is much larger than the palmar, and is rough for ligamentous attachment.

The *inferior* or metacarpal surface is divided by a ridge into two smooth facets for articulation, the inner[4] with the fifth, and the outer[5] with the fourth metacarpal bone.

The *external* surface articulates with the os magnum at the upper and posterior part, by means of a smooth articular facet,[6] and at the lower part by the intervention of an interosseous ligament.[7] The internal surface presents one large articular facet,[8] peculiarly curved for articulation with the cuneiform bone, by which it is overlapped.

THE METACARPUS. (*Plate* VI.)

The metacarpus consists of five bones, which form the body of the hand, and receive their name either numerically, commencing from the thumb, or according to their respective digit; such as the metacarpal bone of the thumb, index, middle, ring, or little finger.

Each metacarpal bone presents a base or upper extremity, by which it articulates with the carpus; a head or inferior extremity by which it articulates with a phalanx; and an intermediate portion, or shaft.

The *head* is somewhat of rounded form, and owing to the greater amount of flexion than of extension of the fingers, continues its articular surface considerably more into the palm than on the dorsum.

On each side of the head is a depression, into which is attached the lateral ligament of the joint.

The *shaft* is concave in its length on the palmar aspect, where it presents a sharp border, and slightly convex on its dorsal aspect, which forms a surface. The interosseous muscles take origin from the lateral-surfaces of the shaft, and distinct markings may be observed for their attachments.

The *bases* differ in each instance, and by this means the several bones may be distinguished one from the other. Each base articulates laterally with its neighbours, except that of the thumb, which alone is free, and thus three bones may be at once partly determined; that of the thumb having no lateral facet at all, that of the index none on its radial side, that of the little finger none on its ulnar side.

The metacarpal bone of the *thumb*[9] is much shorter but stouter than the others. On the palmar surface of its shaft the flexor ossis metacarpi pollicis[14] takes insertion. Its carpal extremity articulates with the saddle-shaped surface of the trapezium,[5] to correspond with which it is concave from before backwards, and convex from side to side. It has no lateral facets since it does not articulate with the other metacarpal bones; but on its outer side is a more or less developed tubercle for the insertion of the extensor ossis metacarpi pollicis.[15]

The metacarpal bone of the *index finger*[10] articulates with three of the carpal bones. The carpal extremity articulates chiefly by a large central facet with the trapezoid;[6] a small portion passing outwards to the trapezium,[5] and another inwards to the os magnum.[7] When viewed from behind it seems to bifurcate and to enclose the trapezoid bone,[6] but on the palmar surface the part which articulates with the os magnum extends into the carpus between that bone and the trapezoid, as a process of some size. Of the lateral surfaces, the inner presents two facets, or, sometimes one for articulation with the middle metacarpal bone;[11] and the outer a tubercle for the insertion of the extensor carpi radialis longior.[16] There is also a tubercle on the palmar surface for the insertion of the flexor carpi radialis.[17]

The *middle* or *third* metacarpal bone[11] may be at once recognized, and its hand determined by a stout process which extends up into the carpus from the posterior surface and outer or radial side of its carpal extremity, and which receives on its dorsal aspect the insertion of the extensor carpi radialis brevior.[18] This extremity further articulates with the os magnum,[7] and on each side with the next metacarpal bone.

The *fourth metacarpal* bone[12] articulates with two bones of the carpus, the os magnum[7] and unciform;[8] and as the facet for the latter is much the larger, and necessarily more internal, the hand to which the bone belongs may be determined. On its inner side is one facet for articulation with the fifth metacarpal bone, on its outer two, or one for the third.

The *fifth metacarpal* bone articulates with the unciform bone,[8] and may be recognized by a tubercle on its internal lateral surface for the insertion of the extensor carpi ulnaris,[19] and a facet on its external lateral surface for articulation with the fourth metacarpal bone.[12]

THE PHALANGES (*Plate* VI.)

are three in number for each finger, except the thumb, for which there are only two. They all resemble one another in being concave on the palmar surface, and convex on the dorsal; and in having a shaft and two enlarged extremities. A phalanx may be recognized as belonging to the first, second, or third row, but to which finger it is impossible to determine, unless all are present, and then only by its length. Two lateral and one palmar ligaments attach the metacarpal bone to the first phalanx, and the phalanges to each other, preventing the extension of the fingers beyond the level of the metacarpus. The phalanges of the first row are very long, compared with those of either the second or the third row, and are much enlarged at their metacarpal extremity. This extremity articulates with the rounded head of the metacarpal bone by a cup-shaped articular surface of very small dimensions, so as to allow a great amount of motion; and by a tubercle on each side it receives the insertion of the interosseous and lumbrical muscles, whilst that of the thumb receives on its outer tubercle[22] the insertion of the abductor pollicis, and external head of the flexor brevis pollicis, on its inner tubercle[23] the adductor pollicis and internal head of the flexor brevis pollicis, and on its dorsal surface the insertion of the extensor primi internodii pollicis. That of the little finger receives on its inner tubercle[25] the insertion of the abductor minimi digiti and flexor brevis minimi digiti.

The shaft of a phalanx along the borders of its palmar surface presents well-defined ridges for the attachment of the sheath of the flexor tendons. The inferior extremity articulates with a middle phalanx by a surface which is concave from side to side, and convex from before backwards.

The phalanges of the second row are far inferior in size to the former, and their bases or larger extremities have on their articular surfaces an antero posterior ridge, rendering the entire facet convex from side to side, and slightly concave from before backwards. The shaft gives insertion by ridges on the borders of its palmar surface to the two slips of the flexor sublimis digitorum,[20] and by its posterior surface to the central of the three slips of the extensor communis digitorum. The inferior extremity is similar to that of the first row. This bone is absent in the thumb.

The phalanges of the third row (ungual) are small and peculiar: they articulate by their bases with the second row, and have the articular surface convex from side to side, concave from before backwards. The shaft receives the insertion of the flexor profundus digitorum[21] on its palmar surface, and on its dorsal surface the two lateral slips of the extensor communis digitorum united; that of the thumb receives the insertion of the flexor longus pollicis on its palmar surface, and of the extensor secundi internodii pollicis on its dorsal surface. The terminal extremity is oval in form, flattened and rough on the palmar surface, but somewhat smooth on the dorsal, which corresponds to the position of the nail.

BONES CONSTITUTING THE PELVIS.

The Sacrum. (*Plate* VII.)

The sacrum is an extension of the vertebral column downwards, and consists of five sacral vertebræ, which, uniting into a triangular or wedge-shaped mass, fit between the ossa innominata, and so form the posterior wall of the pelvis. It is therefore described as one bone, which possesses an anterior, a posterior, and two lateral surfaces, with a base and an apex.

The *anterior* surface following the shape of the bone, is triangular with the base upwards. It is slightly concave from side to side, markedly so from above downwards, and presents four transverse lines[1] which mark the original separation of the sacral vertebræ. At the extremities of these lines on both sides are the four sacral foramina[2] through which the anterior sacral nerves leave the spinal canal. From the foramina grooves pass outwards upon the lateral masses of the bone, and from the ridges separating the grooves, as well as from the surface external to them, corresponding to about three sacral vertebræ, the fibres of the pyriformis muscle[3] take origin.

The *posterior surface* is convex both from above downwards and from side to side, and upon it may be distinguished, though in an imperfect state of development, such parts of the vertebræ as would appear in a posterior view. Along the central line is a crest composed of the rudimentary spinous processes,[4] the first being tolerably distinct, whilst the rest are united together. The fifth is usually altogether absent, and thus the spinal canal at this point becomes uncovered. On each side of the spines the laminæ[5] and articular processes are blended together, though the latter often appear as a range of tubercles, and are well marked upon the fifth sacral vertebra, where, in the form of a process or ridge on each side of the sacral canal, they are termed the cornua[6] or horns of the sacrum, and unite with similar ascending processes, namely the cornua of the coccyx. Still further from the crest appear on each side the four posterior sacral foramina,[7] through which four posterior sacral nerves are transmitted from the canal, whilst the fifth curves beneath the cornu of the sacrum. Lastly, the remainder of the surface corresponds to the transverse processes.[8] It is very rough and tuberculated, and at the lower part gives origin to the glutæus maximus muscle and attachment to the sacro-sciatic ligaments. The erector spinæ muscles take origin from the posterior surface of the sacrum on each side of the crest.

The *lateral surface*[9] articulates with the ilium by means of an ear-shaped portion, described as the auricular surface, and behind and below this it presents a deep and rough depression for the attachment of posterior sacro-iliac ligaments. At the lower part the surface assumes rather the form of a border, and attaches the sacro-sciatic ligaments.

The *base* of the sacrum much resembles a lumbar vertebra. It presents anteriorly the body[10] thrown forwards so as to form a projection termed the promontory of the sacrum, and on each side of this a spreading surface, the ala.[11] Posterior to the body are the articular processes[12] widely separated from each other, and in direction looking backwards and somewhat inwards; next appear the laminæ uniting posteriorly in the spinous process, and the whole enclosing the triangular aperture of the sacro spinal canal.[13] The sacral canal is the continuation of the spinal canal, and contains the termination of the cauda equina. It is laid open at the lower part of the posterior surface of the sacrum, owing to the deficiency of the spine and laminæ of the fifth sacral vertebra.

The *apex*[14] of the sacrum simply presents an oval facet for articulation with the first piece of the coccyx, and around it on each side the anterior fifth sacral nerve turns to the front.

THE COCCYX. (*Plate* VII.)

The coccyx[15] consists of three, four, or five small bones united together, and frequently also united to the sacrum. Like the sacrum they curve forwards, decrease in size from above downwards, and are concave in front, and convex behind. The *anterior* and *posterior* surfaces present the marks of original separation, and attach, respectively, anterior and posterior sacro-coccygeal ligaments. The first coccygeal bone is, when separate, much larger than the rest, and articulates with the apex of the sacrum: upon its posterior surface two processes, the cornua of the coccyx,[16] ascend to meet the descending cornua of the sacrum.

The *lateral borders* of the united bones are irregular, the first bone frequently having a fairly marked transverse process. They give origin to the coccygeus and to the two great gluteal muscles and attachment to the sacro-sciatic ligaments.

The *apex* of the coccyx frequently turns directly forwards, due probably to sitting, and it gives origin to the sphincter ani muscle.

THE OS INNOMINATUM. (*Plate* VII.)

The os innominatum is made up of three bones, the ilium, the ischium and the pubes, all of which unite together in a deep cavity, situated upon the outer aspect of the bone, and termed the acetabulum.

Of the three bones the ilium is by far the largest, and extends upwards in the form of an expanding ala.[1] The ischium, which is next in size, runs downwards, enlarges into the tuberosity[2] for the attachment of strong muscles and to receive the weight of the body in the sitting posture, and then, becoming finer, turns upwards under the name of the ascending ramus[3] of the ischium to meet the pubes.

The pubes, or the smallest of the three bones, extends from the acetabulum at first inwards and nearly horizontally towards its fellow of the opposite side under the name of the horizontal ramus[4] of the pubes. Here it enlarges into a flattened portion and then again descends obliquely outwards, as the descending ramus[5] of the pubes, to join with the ascending ramus of the ischium.[3]

The os innominatum is usually described as one entire bone, presenting two surfaces and four borders.

The *internal surface* is divided into two parts by a horizontal marking, the ilio pectineal line[7] or prominence of the brim of the true pelvis, the part below entering into the formation of the true pelvis, the part above into the false. The part above the line which belongs to the false pelvis, is formed by the ilium only, and is directed inwards and forwards. It presents posteriorly a rough and irregular portion,[8] part of which in the form of an ear articulates with the auricular surface of the sacrum, whilst the rest attaches the sacro-iliac ligament. The anterior part[9] of this division is concave in all directions, and gives origin to the iliacus muscle, whence termed the iliac fossa: and it is usually perforated by the nutrient foramen. The surface below the ilio pectineal line, or that which belongs to the true pelvis, is directed backwards and inwards, and is formed chiefly by the ischium and pubes. It presents a large aperture, the obturator foramen,[10] which in life is occupied by a thin structure, the obturator membrane. This foramen is oval in the male, but in the female it becomes triangular, owing to the greater obliquity of the rami of the pubes and ischium, for the enlargement of the outlet of the pelvis; and it is deeply grooved at its upper margin for the passage of the obturator vessels and nerve. Fibres of the levator ani[11] arise from this surface near the upper portion of the internal margin of the foramen, and a large muscle, the obturator internus,[12] takes origin from the obturator membrane, the borders of the foramen and from the extensive surface posterior to the foramen as far as the margin of the bone.

The *external surface* presents centrally a deep circular cavity, the acetabulum, for articulation with the head of the femur. Its circumference is deficient in the anterior inferior part[13] for the passage of vessels and nerves into the joint, and it gives attachment to a fibro cartilaginous structure termed the cotyloid ligament,[14] which, extending across the notch under the name of the transverse ligament, serves to deepen the entire cavity. In the depths of the acetabulum is an irregular excavation, the sharp margin of which attaches the ligamentum teres,[15] whilst the fossa itself is filled with fat, vessels, &c. The acetabulum is formed by the union of the three bones,[6] about one-fourth by the pubes, and of the remainder, rather more by the ischium than by the ilium. It is surrounded by and gives attachment to the capsular ligament. The surface of bone above the acetabulum corresponds to the ala of the ilium, and is marked by three curved lines, of which the superior[16] is the shortest, and cuts off a small rough portion for the origin of the glutæus maximus.[19] The middle[17] is the longest and most curved, commencing from near the anterior superior spinous process of the ilium and running to the posterior part of the great sciatic notch. The surface between these two curved lines gives origin to the glutæus medius.[20] The inferior[18] curved line is not so well defined as the other two, but may be traced from the anterior inferior spine to the great sciatic notch. Between it and the middle curved line the glutæus minimus[21] arises, and between it and the acetabulum there is a rough marking for the origin of the external head of the rectus femoris.[22]

The surface below, or internal to the acetabulum, presents the outer aspect of the obturator foramen,[10] the inner border of which together with the obturator membrane gives origin to the obturator externus[23] muscle, whose tendon is transmitted through a deep groove[24] situated between the acetabulum and the tuberosity of the ischium. Anterior to the obturator foramen is the surface formed by the junction of the horizontal with the descending ramus of the pubes. From this part the adductor longus[25] takes origin by a rounded tendon, and lower down, the adductor brevis[26] by fleshy fibres, the latter having a much larger origin than the former. From the descending ramus of the pubes and the ascending ramus of the ischium, extending as far as the tuberosity, the adductor magnus[27] arises.

The borders of the os innominatum.—The *superior* border is called also the crest of the ilium. It is convex and much curved, and terminates both in front and behind in prominences termed respectively the anterior[28] and posterior[29] superior spinous processes of the ilium.

It attaches three layers of muscles, and hence may be said to possess three lips, of which the external receives the insertion of the obliquus externus muscle in its anterior three-fourths, whilst of its anterior extremity about one inch and a half gives origin to the tensor fasciæ femoris, and of its posterior a fourth gives origin to the latissimus dorsi.

The middle lip gives origin to the obliquus internus by its anterior two-thirds, and behind this the erector spinæ takes origin.

The internal lip gives origin to the transversalis abdominis by its anterior two-thirds, and by the posterior fourth to the quadratus lumborum. At the anterior superior spinous process[28] Poupart's ligament is attached, and the anterior border commences.

The *anterior* border commences from the anterior superior spinous process, and for the first inch gives origin to the sartorius.[31] It next presents an elevation, the anterior inferior spinous process,[32] from which arises the internal head of the rectus femoris muscle, and to which is attached also the ilio femoral ligament, a collection of fibres which strengthen the capsule of the hip-joint. Below the inferior spine the border becomes smooth, forms a groove[33] for the passage of the tendons of the psoas and iliacus muscles in their exit from the false pelvis, and then again presents an elevation, the ilio pectineal eminence,[34] into which is inserted when present the psoas parvus muscle. From this eminence the ilio-pectineal line extends inwards to terminate in a little process, the spine of the pubes,[35] the line together with the depression in front of it, giving origin to the pectineus muscle,[36] whilst to rather more than an inch of the sharp margin adjoining the spine of the pubes Gimbernat's ligament is attached, and to the spine itself Poupart's ligament. From the spine of the pubes a rough margin, the crest of the pubes,[37] is continued inwards to the termination of the border, about one inch in length. It gives insertion to the external oblique muscle and to the united tendon of the internal oblique and transversalis muscles, and origin to the pyramidalis and rectus abdominis. Descending from the inner point of the crest is an oval surface,[38] rough for the attachment of a fibro-cartilage, by means of which the two pubic bones articulate with each other, and here commences the inferior border.

The *inferior* border is extremely thin, and is formed by the pubes and ischium only. From its anterior margin for rather more than two inches the gracilis muscle[39] takes origin; behind this the crus[40] and erector penis in the male, clitoridis in the female; behind these again the elevator[41] and compressor urethræ or deep transversus perinæi, and low down, near the tuberosity, from a small space, the transversus perinæi.[42] Below this point the border suddenly enlarges into the tuberosity[2] of the ischium, and here becomes separated from the posterior border.

The tuberosity gives origin by a large and distinct roughening[43] at its upper broad part to the hamstring muscles, the semimembranous above and the long head of the biceps and semitendinous below. From the outer border the quadratus femoris[44] and fibres of adductor magnus arise, and from the upper part of the inner border shelving into the lesser sacro-sciatic foramen the gemellus inferior. The inner border projects in the form of a sharp edge of bone which gives attachment to the great sacro-sciatic ligament.[45]

Continuing the circumference of the os innominatum the *posterior border* extends from the tuberosity of the ischium[2] upwards to the posterior superior spinous process[29] of the ilium, from which point the description of the borders was commenced. The posterior border presents immediately above the tuberosity a groove or depression, the lesser sciatic notch,[46] and this by means of the great sacro-sciatic ligament becomes converted into a foramen, through which the obturator internus passes outwards and the pudic vessels and nerves inwards to the perinæum. Separating the lesser sciatic notch from a very extensive space, the greater sciatic notch,[47] is a triangular process, the spine of the ischium.[48]

The spine gives origin by its external surface to the gemellus superior, by its internal surface to the levator ani and coccygeus; and receiving the attachment of the lesser sacro-sciatic ligament at its apex, converts the great sciatic notch[47] into a large foramen, through which the gluteal vessels and nerve, the pyriformis muscle, the sciatic vessels and nerves, and the pudic vessels and nerve, and filaments of the sympathetic nerve leave the pelvis in order from above downwards. Above the great sciatic notch is the posterior inferior spinous process,[49] and this is separated by a small notch only from the posterior superior spinous process[29] of the ilium, from which the superior border has been seen to commence.

THE PELVIS. (*Plate* II.)

The pelvis is the space enclosed by the sacrum and ossa innominata, but since the iliac portions of those bones ascend considerably above the sacrum, and one portion of the cavity is more capacious than the other, it has been divided into a *true* and a *false* pelvis.

The *false pelvis* is bounded laterally by the expanding alæ[2] of the iliac bones, having behind the last lumbar vertebra,[3] between which and the ala is the ilio-lumbar ligament, and in front an open space limited only by the softer tissues of the abdominal walls. The cavity thus formed is much more extensive at its upper than at its lower portion, and is separated from the true pelvis by what is termed the brim of that space. The brim commences in front with the horizontal ramus[4] of the pubis, and passes backwards through the ilio-pectineal eminence[5] and along the ilio-pectineal line[6] to the sacro-iliac synchondrosis,[7] where the promontory of the sacrum connects this border with that of the opposite side. The cavity contains a very large portion of the intestinal canal, as well as muscles, vessels, and nerves; and it has consequently been connected in the description of the abdominal cavity, and divided into three regions, a right and a left iliac, and a centre or hypogastric. The inner surface of each ala is termed the iliac fossa; it gives origin to the iliac muscle; and is occupied on the right side by the cœcum and on the left by the sigmoid flexure of the colon. The central portion is occupied by convolutions of the small intestines, by the upper part of the bladder when that viscus is distended, and in the female during gestation by the gravid uterus.

The minutiæ of the external parts of the osseous boundary of the false pelvis, namely, the outer surface and the margins of the ala of the iliac bone, have previously been described. (Page 39, &c.)

The *true pelvis* is a cavity of smaller dimensions than the false pelvis, and is bounded by strong osseous walls, which are formed posteriorly by the sacrum[1] and coccyx, laterally and in front by the ischial and pubic bones; it is therefore much deeper behind than in front. It is the space through which the child passes in parturition. It possesses a superior aperture or brim, and an inferior aperture or outlet, and, in consequence of the curve taken by the cavity, and of its irregular depth, it follows that these apertures occur in a plane, horizontal neither to each other nor to the body.

The superior aperture or brim of the true pelvis has already been mentioned as the line of separation between it and the false pelvis. It is slightly larger in the male from before backwards than from side to side; it is indented posteriorly by the promontory of the sacrum; and it is placed very obliquely with regard to the central line of the body, so that its axis would occur in a line drawn from the umbilicus to the tip of the coccyx. The inferior aperture of the osseous pelvis is extremely irregular, being indented laterally by the greater and lesser sciatic notches, and having the projection of the coccyx posteriorly; but it is rendered more regular in form and smaller in size by the greater and lesser sacro sciatic ligaments, which extend from the lateral margins of the coccyx and sacrum to the tuberosity and spine of the ischium. The plane of this aperture is such that its axis would be within the line drawn from the promontory of the sacrum through a point midway between the tuberosities of the ischia.

The cavity of the true pelvis curves in accordance with the sacrum, and is occupied by the bladder and rectum, by large vessels and nerves; also in the male by the prostate gland, vesiculæ seminales, and vasa deferentia, and in the female by the vagina, uterus and ovaries.

The female pelvis differs in many points from that of the male. It is less developed for strength and more delicately formed, but it is of larger dimensions, particularly in the transverse diameter. In the false pelvis the alæ are more shallow but extended in width, and in the true pelvis the brim is oval, with the long diameter from side to side. The pubic arch is larger, smoother on its posterior aspect, and is rounded at the symphysis pubis, not ascending to a sharp angle, as in the male.

The obturator foramen is more triangular, its inner portion being cut off by the great divergence of the sides of the pubic arch. Lastly, the sacrum is somewhat shorter, but broader and less curved, and the coccyx more movable; whilst the whole cavity is not so deep as in the male. The sacrum is less curved in the female because the promontory is not so prominent.

THE LOWER EXTREMITY.

THE FEMUR. (*Plate* VIII.)

The femur is the only bone in the thigh. It articulates with the os innominatum by means of a rounded *head*[1] projecting obliquely inwards, and upwards from the shaft of the bone, to which it is connected by the intervention of a contracted portion or neck.[3] The head is in shape about two-thirds of a sphere, and is smooth for articulation with the acetabulum. The articular surface is surrounded by a line which marks the attachment or extent of the articular cartilage, but near its centre it presents a roughened depression in which is attached the ligamentum teres.[2]

The *neck* supports the head upon its summit, and is attached to the shaft by its base. It is flattened from before backwards, extends upwards and inwards with an obliquity gradually decreasing as the subject advances in years, and it is marked throughout with numerous vascular foramina. At the junction of the neck with the shaft there is formed anteriorly a well-defined line for the attachment of the capsule of the hip-joint, but posteriorly this ligament is attached more closely to the head and not to so rough a line. There is, however, more externally, on the posterior aspect, an elevated ridge uniting together two large processes, the trochanters, and hence called the intertrochanteric ridge.

The *trochanter major*[4] is a continuation of the shaft upwards, projecting above the level of the neck, and may be said to be of quadrilateral form, having four borders and two surfaces. The anterior border presents a rough depression for the insertion of the glutæus minimus;[6] the posterior forms the intertrochanteric ridge; the superior[7] gives insertion to the pyriformis, gemellus superior, obturator internus, and gemellus inferior, the tendon of these muscles extending downwards, upon the inner surface of the great trochanter towards the digital fossa; and the inferior border is simply a line separating the trochanter from the outer surface of the shaft, and marking the uppermost origin of the vastus externus.[10] With regard to the surfaces, the internal exhibits a large depression, the digital fossa,[8] which receives the inserting tendon of the obturator externus; and the external is divided into two portions by a line running from behind downwards and forwards, an upper or anterior, for the insertion of the glutæus medius,[9] and a lower or posterior, which is covered by a synovial sac to permit the gliding motion of the tendon of the glutæus maximus.

The *trochanter minor*[5] is a rounded prominence at the inner and posterior part of the upper extremity of the bone, the lower end of the intertrochanteric ridge. It gives insertion to the united tendon of the psoas magnus and iliacus muscles.

The *shaft* of the femur is cylindrical in form, curved forwards slightly in its length and inclining inwards towards the knees, so it follows that the femur of a female would have a greater inclination inwards than that of a male, in consequence of the greater breadth of the female pelvis. The shaft presents on its posterior aspect a strongly marked longitudinal ridge, the linea aspera, and this communicates above with both trochanters, and below bifurcates into two lines, which, leading to the condyles, are termed the condyloid ridges. The linea aspera may be said to consist of three fine lines separated from each other by two intervals, as thus the mode of attachment of muscles becomes much simplified. The external of the three lines gives origin to the vastus externus,[10] from the great trochanter to the upper third of the external condyloid ridge; the internal gives origin to the vastus internus,[11] a muscle which also arises from the line leading from the lesser trochanter; and the middle, in its whole extent from the trochanter major to its termination, gives insertion to the adductor magnus,[12] whilst a continuation of this line upwards upon the posterior border of the trochanter major gives insertion to the quadratus femoris,[13] and receives the name of the linea quadrati. Now, concerning the intervals between these lines, the external, which lies between the adductor magnus and vastus externus, is roughened by two muscles, the insertion of the glutæus maximus[14] in its uppermost three inches and the origin of the short head of the biceps[15] in its lower half. The internal interval, which lies between the adductor magnus and the vastus internus, gives insertion by its middle third to the adductor longus,[16] and above and slightly external to this to the adductor brevis.[17] From this point the line ascends to the lesser trochanter, and into it the pectineus[18] is inserted.

The *internal surface* of the shaft gives origin to the vastus internus,[11] the *external surface* to the vastus externus[10] near the trochanter major, but not to any extent downwards. The anterior surface gives origin to the crureus[19] in about its upper half or two-thirds, and nearer the lower part to a small muscle, the subcrureus.[20]

The *lower extremity* of the femur increases suddenly to a large size when compared with the size of the shaft. It consists of two large articular masses termed condyles, separated from each other posteriorly by a considerable space, the intercondyloid notch, but continuous anteriorly.

The internal condyle[21] is the larger, projects more laterally and extends lower, but the external[22] is thrown more forward of the two. Each articulates with the tibia by an inferior convex surface, which is smooth for the articular cartilage, and this smoothness extends upwards upon the posterior surface for the same articulation in flexion of the leg, and also upwards upon the anterior surface for articulation with the patella. It must be noticed that the surface for articulation with the patella is continuous upon the two condyles, an antero-posterior groove alone marking the separation, but that the portion upon the external condyle is much the larger, being broader and extending higher. By this means it will be afterwards seen that the side to which the patella belongs may be at once recognized. The lateral prominence of the internal condyle gives attachment to the internal lateral ligament, and projects upwards and backwards in the form of a small tubercle, which, on looking to the back of the bone, is found to be the termination of the internal condyloid ridge, and gives insertion to the tendon of the adductor magnus[12] muscle. The lateral prominence on the external condyle attaches the external lateral ligament, and immediately below this may be seen a small fossa which gives origin to the popliteus muscle,[23] and from which a groove covered with cartilage extends backwards occupied by the tendon of the same muscle.

A posterior view of the entire lower extremity of the femur presents the intercondyloid notch, in the sides of which, formed by the outer surface of the internal condyle and the inner surface of the external condyle are rough depressions for the attachment of the posterior[25] and anterior[24] crucial ligament respectively. Altogether above the condyles is a triangular space between the two condyloid ridges, and within this space, upon the outer side,[26] immediately above the articular surface of the external condyle, the plantaris and the outer head of the gastrocnemius take origin, the former often from a small fossa. Above the articular surface of the internal condyle arises the internal head of the gastrocnemius;[27] and here again may be noticed the tubercle for the insertion of the adductor magnus.

THE PATELLA.

The patella, or knee-cap, is a small triangular bone, frequently described as sesamoid, or contained within the tendon of the quadriceps extensor muscle. It is situated over the knee-joint, its base upwards, its posterior surface gliding upon and articulating with the condyles of the femur.

The *anterior surface* is subcutaneous, being covered only by a bursa and the integument; into it are inserted fibres of the quadriceps extensor, giving it an appearance longitudinally like the grain in wood.

The *posterior surface* is chiefly articular and presents two fossæ, separated from each other by an elevation, and exactly adapted to the anterior part of the articular surface of the lower extremity of the femur. As mentioned in the description of the femur, the external of the two depressions is the larger and deeper, to correspond with the external condyle, and thus the side to which the bone belongs may be determined. The lower part of the posterior surface is non-articular and overlaps the joint. The *base* of the bone is upwards, and gives insertion to fibres of the quadriceps extensor. The *apex* is directed downwards, and attaches the ligamentum patellæ.

The *lateral borders* are connected also with the tendon of the quadriceps extensor, and with this and the ligamentum patellæ the two lateral ligaments of the knee-joint are connected.

THE TIBIA. (*Plate* VIII.)

The tibia is the internal and larger of the two bones of the leg.

The *superior extremity,* which alone articulates with the femur and receives the weight of the entire body, is very considerably larger than any other portion of the bone. Its superior surface,[1] by which it articulates with the femur, presents two large and smooth depressions, separated from each other by an elevated process of bone, the spine[2] of the tibia. The depressions articulate with the condyles of the femur, and are deepened by means of a semilune of inter-articular fibro-cartilage, situated upon their free margins; whilst the spine itself, which is bifid at the apex, ascends in the interval described as the intercondyloid space of the femur. The spine gives attachment to the anterior and posterior extremities of the external semilunar cartilage, but not to those of the internal, which do not so closely approach it; and from a rough depression immediately in front and behind the spine the anterior and posterior crucial ligaments take strong attachment. For the purpose of supporting the articular depressions the upper extremity of the tibia projects considerably on each side, and the prominences are termed the internal[3] and external[4] tuberosities.

The internal tuberosity,[5] which is the larger of the two, gives attachment by the lateral portion of its circumference to the internal lateral ligament, and into a rough depression at its posterior part the semimembranosus[5] muscle is inserted. The external tuberosity presents on the posterior part of its circumference a small facet,[6] the direction of which is outwards, downwards and backwards for articulation with the head of the fibula, and in contact with this, but above behind and internal to it, there is a smooth groove,[7] along which the popliteus muscle runs to its insertion, whilst immediately in front of the facet a few fibres of the extensor communis digitorum arise.

The anterior aspect of the upper extremity of the tibia presents only a solid protuberance of bone termed the tubercle,[8] which gives attachment to the ligamentum patellæ, or, as it may be described, the tendon of the quadriceps extensor; a bursa intervening between the tendon and the bone.

The *shaft* of the tibia is markedly triangular, having three distinct surfaces, separated by three borders. The *anterior* border[9] extends from the tubercle downwards to the lower extremity. It is commonly called the shin-bone and is sharp and prominent in its upper three-fourths, but in the lower fourth it is smooth and curves inwards towards the malleolus, in consequence of the passage of the extensor tendons over this part of the bone. The *internal* border[10] extends from the internal tuberosity to the posterior margin of the malleolus, and it is most developed in its central third, where fibres of the soleus muscle arise.

The *external* border[11] commences from the articular facet for the fibula, and extending downwards, bifurcates below for the production of a groove in which the lower extremity of the fibula is fixed. To this border is attached the interosseus membrane between it and the fibula.

The *internal surface*[13] is situated between the anterior and internal borders, and may be felt upon the inner side of the leg, subcutaneous in its whole extent and continuous with the inner surface of the malleolus. Upon its upper part, about the level of the tubercle of the tibia, three muscles,[14] the sartorius, gracilis, and semitendinosus take insertion, uniting and sending processes of their tendon to strengthen the thick aponeurotic fascia of the leg.

The *external surface*[15] is situated between the anterior and external borders. For the greater part of its extent it looks directly outwards, and gives origin to the tibialis anticus, but the lower fourth of the surface following the course of the anterior border curves over the front of the lower extremity of the tibia and becomes smooth for the passage of the extensor tendons.

The *posterior surface* occupies the space between the external and internal borders. In the upper third a distinct line[16] may be observed running from the articular facet for the fibula downwards and inwards to the internal border thus cutting off a triangular portion above the line for the insertion of the popliteus muscle.[17] The line itself gives origin to part of the soleus, and the surface below the line, which is perforated by the nutrient canal in a downward direction, gives origin as far as its lower third to two muscles, the flexor longus digitorum[18] chiefly, and at the outer part near the external border to the tibialis posticus.[19]

The *lower extremity* of the tibia is somewhat larger than the shaft, and by its articulation with the astragalus is the means of transmitting the weight of the body upon the tarsus. From its inner side a triangular process of bone, termed the internal malleolus[20] projects downwards internal to the astragalus so as to assist in keeping that bone in position in the ankle-joint. Its apex[23] gives attachment to the internal lateral ligament.

The inferior or articular surface[21] of this extremity is quadrilateral, concave from before backwards but sinuously curved laterally, and extends downwards upon the outer surface of the internal malleolus. It articulates with the upper and with the internal surface of the astragalus.

The anterior surface is continuous with the anterior surface of the shaft, and is crossed by the same extensor tendons, whilst its margin gives attachment to the anterior ligament of the ankle-joint.

The posterior surface is continuous with the posterior surface of the shaft, and is crossed by the tendon of the flexor longus pollicis. This aspect of the malleolus is deeply grooved[24] by the tendons of the tibialis posticus and flexor communis digitorum muscles.

The internal surface of the extremity, that is, the malleolus, is subcutaneous.

The external surface is concave from before backwards for the reception of the fibula, to which it is connected by ligaments, and its margins are formed as before mentioned by the bifurcation of the external border.

THE FIBULA. (*Plate* VIII.)

The fibula is a long and slender bone, situated upon the outer side of the leg. It is slightly curved backwards, so that from its upper to its lower extremity it becomes concave.

The *head* or upper extremity presents a facet[1] upon its upper and internal part, which is directed upwards, forwards and inwards for articulation with a similar facet upon the external tuberosity of the tibia. The margins of this facet attach the anterior and posterior ligaments of the superior tibio-fibular articulation. Posteriorly the head is prolonged upwards in the form of a conical process of bone, the styloid process,[2] to the apex of which the short external lateral ligament of the knee-joint is attached, and from whose base the soleus muscle takes origin. The outer surface of the head attaches the long external lateral ligament of the knee-joint, and gives insertion to the tendon of the biceps,[3] whilst from the anterior part some fibres of the extensor longus digitorum and external to them, fibres of the peroneus longus arise.

Passing now to the shaft, four lines or ridges may be determined, none of which really extend the length of the bone, and therefore they can scarcely be designated borders, but they are sufficient to separate and define certain portions or surfaces. These lines from their position may be termed anterior external[5] and internal,[4] and posterior external[7] and internal[6], and, when recognized, the fibula, usually considered so difficult, becomes comparatively simple. From the front of the head one ridge descends for a short distance and divides into two, one of which, the *anterior internal* line,[4] inclines inwards and attaches the interosseous membrane between the fibula and tibia; it is called the interosseus line, and terminates below in a rough ligamentous portion,[8] where the two bones are connected together by a strong interosseus ligament. The other line, the *anterior external,*[5] running downwards, curves outwards to the centre of the external surface of the malleolus; and about two inches above its termination a short line extends from it to the anterior border of the malleolus, and thus cuts off a portion of the bone which may be felt beneath the integument immediately above the outer ankle.

A posterior view of the bone exhibits the remaining two lines. Of these the *posterior external*[7] runs from the outer part of the base of the styloid process downwards to the posterior margin of the external malleolus, and is often indistinct at the upper part; whilst the *posterior internal*[6] runs from the inner part of the base of the styloid process downwards obliquely towards the interosseous line, which it may or may not join about the lower fourth of the bone.

The space between the anterior external[5] and anterior internal[4] lines is the *anterior surface* of the fibula. It is extremely narrow above but widens as it descends, and gives origin to three muscles, the extensor communis digitorum longus,[9] peroneus tertius,[10] and extensor proprius pollicis.[11] The second of these is continuous with the first, and both arise as one muscle from the upper four-fifths. Internal to them and closer to the interosseus line the extensor proprius pollicis arises from the lower two-thirds.

The *external surface* lies between the anterior external[5] and the posterior external[7] lines. In the upper part it appears as a deep groove, and below turns to the back of the external malleolus, giving origin to two muscles,[12] the peroneus longus by its upper,$\frac{2}{3}$ and peroneus brevis by its lower,$\frac{2}{3}$ the latter being in front of the former. The *posterior surface* lies between the posterior external[7] and the posterior internal[6] lines. In the upper third it is much roughened, and gives origin to the soleus muscle,[13] but in the lower two-thirds it becomes smooth, and with the exception of the lowest two inches gives origin to the flexor longus pollicis muscle.[14]

Between the posterior internal line[6] and the interosseous[4] line there yet remains a longitudinally grooved portion of the bone, which occupies about two-thirds the length of the fibula. This part may be described as the *internal surface*, and gives origin to the tibialis posticus muscle.[15]

The *lower extremity* of the fibula or external malleolus is of pyramidal form, attached to the shaft by its base. Its internal surface presents a triangular facet,[16] smooth for articulation with the astragalus; whilst behind and below this there is a deep and rough depression for the attachment of the posterior fasciculus of the external lateral ligament of the ankle-joint. The external surface of the malleolus is divided into two parts by a prominent ridge which is continuous with the anterior external border of the shaft, namely, an anterior[19] or subcutaneous part, and a posterior part[17] which is continuous with the external surface of the shaft, and is grooved by the tendons of the peroneus longus and brevis in their passage to the foot.

The anterior border of the malleolus gives attachment to the anterior fasciculus of the external lateral ligament of the ankle-joint, and the apex gives attachment to the middle fasciculus[18] of the same. The posterior border is smooth and bevelled.

THE TARSUS. (*Plates* IX & X.)

The tarsus is composed of seven bones: the os calcis; astragalus; scaphoid; three cuneiform, internal, middle and external; and the cuboid bone. All of these present six sides tolerably distinct.

THE OS CALCIS, OR CALCANEUM. (*Plate* IX.)

The os calcis is the largest of the tarsal bones, and gives the form to the heel. The *superior surface* is divided into two unequal parts, a posterior,[1] which is smooth, concave from behind forwards, and occupied in the living subject by a mass of loose fat and cellular tissue; and an anterior[2] much larger, overlapped by the astragalus, and presenting a deep groove[3] between two articular facets. Of the two facets, both of which articulate with the astragalus, the posterior is convex for the reception of the body of that bone and its posterior and outer margins attach the posterior and external astragalo-calcanean ligaments; whilst the anterior is elongated and concave for the reception of the head, and this projecting considerably on the inner side there takes the name of the sustentaculum tali.[4] The anterior border of this facet gives attachment to the inferior calcaneo scaphoid ligament, the separating groove[3] in direction forwards and outwards being rough for the attachment of the strong interosseus astragalo calcanean ligament, which binds the two bones firmly together. In front of the groove the extensor communis brevis digitorum[5] takes origin.

The *inferior surface* presents posteriorly two tubercles, an internal,[6] which is large, and by its inner surface gives origin to the abductor pollicis and flexor brevis digitorum muscles, and an external,[7] small, for the origin of the abductor minimi digiti. Between the two tubercles the plantar fascia is attached, and in front of them a rough depression gives attachment to the long plantar or long calcaneo-cuboid ligament.[8] As this surface extends forwards it gradually narrows and terminates anteriorly in a third tubercle, which, together with a roughened fossa in its front, give attachment to the short plantar or short calcaneo cuboid ligament.[9] The *anterior surface*[10] is entirely smooth for articulation with the cuboid bone, and may be seen to recede above, but protrudes below. The *posterior surface* receives the insertion of the tendo achillis[11] by a well-defined roughened marking at the lower part: above this it is smooth, a bursa here intervening between the tendon and the bone. The *external surface* is flat, but gives attachment to the middle fasciculus[12] of the external lateral ligament by a tolerably distinct tubercle near its centre, and in front of this, in a well-marked bone, a groove may be defined separable into two parts for the transmission of the peroneus brevis above and peroneus longus below. The *internal surface* is smooth, and gives origin to the flexor accessorius muscle,[14] and owing to the prominence of the sustentaculum tali, it presents a large open space through which the posterior tibial vessels and nerve together with the tibialis posticus, flexor communis digitorum and flexor longus pollicis muscles pass into the sole of the foot, the last muscle occupying a groove[13] on the under surface of the sustentaculum tali.

THE ASTRAGALUS. (*Plate* IX.)

The astragalus is the only bone which supports the leg and transmits its weight upon the tarsus. It presents a body,[1] and running forwards and inwards a rounded process or head,[3] attached to the body by a contracted portion or neck.[2] The *superior surface* articulates with the tibia by a large quadrilateral smooth surface, which is broader in front than behind, so as to allow a greater amount of motion when the foot is extended; and in front of this is a rough depression[4] upon the neck for the attachment of the anterior fasciculus of the external lateral ligament, and the anterior tibio tarsal ligament. The *inferior surface* articulates with the os calcis by two facets, a posterior[5] large and concave, broader from side to side, and attaching by its posterior and outer margins the posterior and external astragalo calcanean ligaments, and an anterior[6] convex situated beneath the head, and peculiar in that a portion of it articulates, not with the os calcis, but with the calcaneo scaphoid ligament, for the purpose of increasing the elasticity of the arch of the foot. The two facets are separated by a deep depression,[7] into which is attached the calcaneo astragaloid ligament.

The *anterior surface*[8] is convex, longer in the transverse diameter, and smooth for articulation with a corresponding concavity in the posterior surface of the scaphoid bone. The *posterior surface* is very small from above downwards, and is occupied by a groove running inwards for the passage of the flexor longus pollicis muscle.[9]

The *external surface* is mainly composed of a smooth triangular facet,[10] with the base upwards, and concave from above downwards. It is very much larger than the facet on the inner surface, thus rendering the two sides of the bone easily recognized, and it articulates with the outer malleolus or inferior extremity of the fibula. To a roughened depression behind this facet, the posterior division of the external lateral ligament is attached.

The *internal surface* is small, and, by a somewhat semilunar facet[11] at the upper border, articulates with the internal malleolus or lower extremity of the tibia, whilst its lower half is rough and gives attachment to the internal lateral ligament.[12]

THE SCAPHOID BONE. (*Plate* X.)

The scaphoid bone, named from its resemblance to a boat, is situated upon the inner side of the foot. Its *posterior surface*[1] is pear-shaped, with the narrow extremity inwards, it is deeply concave, and forms a socket for the head of the astragalus. The *anterior surface* is convex from side to side, and marked by two ridges separating the whole into three facets [2, 3, 4] for articulation with the three cuneiform bones. The *internal surface*, or, more properly speaking, the internal extremity, is rough and tuberculated, and gives insertion below to the tibialis posticus muscle.[5]

The *external surface* is often marked by a facet[6] for articulation with the cuboid bone, and it attaches scapho-cuboid and external calcaneo scaphoid ligaments. The *superior surface*[7] is convex, and roughened by the attachment of ligaments, which pass from it to all the bones of the tarsus except the os calcis, and the inferior surface[8] is rough for the attachment of tarsal ligaments, especially the inferior calcaneo scaphoid, upon which, being formed of yellow elastic tissue, depends the entire elasticity of the arch of the foot.

THE INTERNAL CUNEIFORM BONE. (*Plate* X.)

The internal cuneiform bone resembles a wedge, and is situated in the tarsus, with its thin border upwards on the dorsum of the foot. The *posterior surface*[1] is concave and smooth for articulation with the internal facet upon the anterior surface of the scaphoid. The *anterior surface*[2] likewise presents an articular facet, but this facet is far longer from above downwards than from side to side; it is somewhat convex, and articulates with the metatarsal bone of the great toe. The *external surface* is that in contact with the middle cuneiform bone, with which it articulates by means of a peculiar, narrow facet,[3] extending along the upper and the posterior borders. There is always a more or less distinctly marked facet[4] at the anterior extremity of the upper border for articulation with the second metatarsal bone, and the rest of the surface is rough for the attachment of the interosseous ligament between it and the middle cuneiform.

The *internal surface* is convex from above downwards, and is marked near the lower border by a smooth surface[5] for the tendon of the tibialis anticus to play over.

The *superior portion* of the bone is the sharp border of the wedge, and appears on the dorsum of the foot, and attaches dorsal tarsal ligaments.

The inferior surface[6] or base of the wedge, projects into the sole of the foot considerably lower than either of the other cuneiform bones, and receives the insertion of the tibialis anticus, as well as some fibres of the tibialis posticus. It also attaches plantar tarsal ligaments.

The Middde Cuneiform. (*Plate* X.)

The middle cuneiform is much the smallest of the three, and resembles a wedge with the base upwards. The *posterior surface*[1] is somewhat triangular, concave from above downwards, and articulates with the central facet on the anterior surface of the scaphoid.

The *anterior surface*[2] is triangular, smaller than the posterior, and articulates with the base of the second metatarsal bone. The *internal surface* presents an articular facet[3] exactly corresponding to that on the outer side of the internal cuneiform bone with which it articulates. This facet is long and narrow, and occupies the posterior and superior borders, whilst the rest of the surface is rough for the attachment of the interosseous ligament.

The *external surface* is smooth[4] posteriorly for articulation with the external cuneiform, rough anteriorly for the attachment of the interosseous ligament between it and the same bone.

The *superior surface,* or base of the wedge, is on the dorsum of the foot, and gives attachment to dorsal ligaments. The *inferior aspect* or edge of the wedge extends into the sole.

THE EXTERNAL CUNEIFORM. (*Plate* X.)

The external cuneiform is intermediate in size between the other two, and resembles a wedge with its base upwards. The *posterior surface*[1] articulates with the outermost facet of the scaphoid bone by a smooth facet obliquely placed from side to side and concave as though adapted to a sphere. The *anterior surface*[2] is somewhat triangular and articulates with the third metatarsal bone, projecting slightly into the metatarsus between the second and fourth bones of that region.

The *internal surface* presents a facet[3] upon its posterior margin elongated from above downwards, and somewhat irregular, for articulation with the middle cuneiform bone; whilst at the anterior margin there are two small facets, one above the other, and frequently united into a narrow elongated surface,[4] for articulation with corresponding facets, or surface upon the outer side of the base of the second metatarsal bone. The rest of the surface is rough for the attachment of an interosseous ligament between the two bones. The *external surface* articulates with the cuboid bone by a large facet[5] at its posterior and upper portion, and with the fourth metatarsal bone by a small facet[6] at the upper extremity of the anterior margin.

The *superior surface,* which is seen on the dorsum of the foot, gives attachment to dorsal ligaments, and the *inferior* *aspect* or sharp margin of the wedge gives attachment to plantar ligaments.

THE CUBOID BONE. (*Plate* IX.)

The cuboid is the outermost of the smaller tarsal bones. The *posterior surface*[4] is altogether smooth for articulation with the os calcis, and at its inferior and inner part projects backwards to underlap the articular surface of that bone, and so to materially strengthen the joint.

The *anterior* or metatarsal surface articulates with the fourth[5] and fifth[6] metatarsal bones, and is therefore divided into two articular facets by a slight elevation, the external[6] of the two, or that for the metatarsal bone of the little toe, being the larger.

The *internal surface* articulates with the external cuneiform bone by a large facet[7] near the centre, and with the scaphoid bone by a small facet[8] at the posterior and upper angle, the rest of the surface giving attachment to interosseous ligaments.

The *external aspect* of the bone approaches more to the form of a border than a surface. It is very narrow and is excavated by a groove[2] for the tendon of the peroneus longus muscle.

The *dorsal surface*[1] is slightly convex and turned considerably outwards. It is somewhat rough for the attachment of the dorsal tarsal ligament which attach it to those bones with which it articulates.

The *plantar surface* presents a deep groove[2] running from without forwards and inwards for the passage of the peroneus longus tendon. The posterior ridge of the groove attaches the long plantar or calcaneo-cuboid ligament, and the portion of the surface behind it attaches the short calcaneo-cuboid ligament. The rest of the surface attaches fibres of the flexor brevis pollicis, and also ligamentous fibres which unite it with the metatarsus, and with the external cuneiform and scaphoid bone.

THE METATARSAL BONES. (*Plate* XI.)

The metatarsal bones are five in number, named in order from the great to the little toe, first, second, third, fourth, fifth, and intervening in position between the small bones of the tarsus and the first row of the phalanges. Each possesses a tarsal and phalangeal extremity and a shaft, and thus resembles one of the long bones on a small scale.

The *tarsal extremity* articulates with the tarsus by means of its terminal facet, a triangular surface with the base upwards. Each side is in contact with the adjacent metatarsal bone, and consequently possesses distinguishing articular facets. The portions of this extremity which occupy the sole or dorsum of the foot give attachment to ligaments which extend to all the bones articulating.

The *phalangeal* or *anterior* extremity is rounded or globular, and smooth for articulation with the first phalanx, but laterally is rough, grooved, and marked by a tubercle for the attachment of the lateral ligaments. The heads of the four outer bones give origin to fibres of the transversus pedis muscle.

The *shaft* is somewhat curved, so as to render the dorsum of the foot convex and the sole concave: it presents three surfaces, two lateral and one dorsal, the former giving origin to interosseous muscles. The dorsal surface of the shaft shelves downwards and outwards so that a right or left bone may be readily recognized.

The *first* metatarsal bone, or that of the great toe, is a large and powerfully constructed bone. It is situated at the inner side of the foot, and does not articulate with the adjacent metatarsal bone. Its tarsal articular surface is large and somewhat of a kidney shape, having its concave margin externally, and articulates only with the internal cuneiform bone.

The inferior aspect of the tarsal extremity is tuberculated and prolonged downwards into the plantar region, and gives insertion to the peroneus longus tendon.

The shaft of the bone is thick and angular. Its outer surface, which faces the second bone of the series, is curved longitudinally in a concave manner, and gives origin posteriorly to the first dorsal interosseus muscle. The head is large and broad, and has upon its plantar aspect two small depressions with which the sesamoid bones lie in contact.

The *second* metatarsal bone is the longest of the series. The tarsal extremity projects backwards between the bones of the tarsus and articulates with the middle cuneiform bone by its terminal triangular surface.

The outer side of this extremity presents four small articular facets, of which the two posterior frequently unite and form a narrow elongated surface for articulation with the internal surface of the external cuneiform bone; whilst the two anterior facets are for articulation with the third metatarsal bone.

The inner side of the tarsal extremity presents only one facet at its upper angle for articulation with the outer side of the internal cuneiform bone.

The *third* metatarsal bone articulates by the terminal triangular surface of its base with the external cuneiform bone. Its internal side articulates with the second metatarsal bone by two facets, one above the other, corresponding to the two anterior of the four facets described on that bone. Its outer side has but one facet, for articulation with the fourth metatarsal bone.

The *fourth* metatarsal bone articulates by the terminal surface of its base with the cuboid bone. This surface is quadrilateral, and not triangular as the other metatarsal bones. The outer side of the base has one facet for articulation with the fifth metatarsal bone, but the inner side articulates with the third metatarsal bone, and also with the outer surface of the external cuneiform bone. It has therefore two facets, one in front of the other, and may thus be recognized from the third metatarsal bone, whose two internal facets are one above the other.

The *fifth* metatarsal bone may be at once recognized by its flat and extensive tarsal extremity.

The terminal surface is somewhat triangular, but elongated in the lateral direction, and articulates with the cuboid bone.

The outer side of the base projects considerably outwards and backwards, and may be termed the tuberosity. It receives the insertion of the peroneus brevis tendon.[15]

The inner side of the base articulates with the fourth metatarsal bone by one single facet.

The shaft of this bone differs from the shafts of the remainder of the series in being flattened upon its dorsal and plantar surfaces, instead of upon its lateral surfaces.

Its dorsal surface receives the insertion of the peroneus tertius near its centre, and its plantar surface gives origin to the flexor brevis minimi digiti.

THE PHALANGES (TOES). (*Plate* XI.)

Great similarity exists between the hand and the foot with regard to the phalanges. The toes are the same in number as the fingers, and each toe, like the fingers, possesses three phalanges, with the exception of the great toe which, corresponding to the thumb in the hand, possesses only two, the central being absent. The second toe corresponds to the third finger in muscular attachments. A description verbatim of the digital phalanges would be equally applicable to those of the foot.

The toes from birth are somewhat shorter than the fingers, but in an adult the second and third rows of phalanges are found to be much stunted in their growth, possessing little or no shaft, and nodulated in appearance. They are frequently also in one or more toes ossified together.

SESAMOID BONES.

Sesamoid bones are small nodules occurring in the substance of tendons where lying in contact with bones.

The surface opposed to the bone is smooth, and resembles an articular facet, but the rest of the nodule is rounded, or irregular, and entirely covered by the fibres of the tendon. Two such small bones are found always in the tendons of the flexor brevis pollicis under the first joint of the great toe, the head of the metatarsal bone presenting a marked facet upon each side under which they glide. In the flexor brevis pollicis of the ball of the thumb two are also usually found, and occasionally in one or more of the fingers and toes in the same position. The tendon of the peroneus longus contains one of large size at the commencement of the groove in the plantar aspect of the cuboid bone; and again, where the tibialis anticus tendon lies upon the internal cuneiform bone previous to its insertion, a sesamoid bone intervenes.

The patella is but a large sesamoid bone contained in the tendon of the quadriceps extensor.

The useof these bones is for leverage, for alteration in the direction of force, and as an economical arrangement against friction.

THE SKULL.

[In studying the separate bones of the skull, it is advisable to articulate each with those contiguous, and to have an entire skull for constant reference.]

THE skull is composed of two separate sets of bones; one set, eight in number, for the formation of a cavity in which the brain is contained, and which is designated the cranium; and another set of fourteen bones, which pertain only to the face. The eight cranial bones are the occipital, two parietal, two temporal, frontal, sphenoid and ethmoid.

THE OCCIPITAL BONE. (*Plate* XII.)

The occipital bone assists in forming the posterior and inferior portions of the cranium, and is curved in such a manner that a part is perpendicular and a part horizontal. Looking at the bone from within, that is, its *cerebral surface,* it presents a marked eminence or thickened portion, the internal spine[1] and double lines or grooves passing from this spine in a crucial manner. At this point is situated the torcular Herophili, or meeting of the sinuses, one of which, the longitudinal sinus,[2] occupies the groove which extends from the spine upwards, whilst the borders of the same attach a portion of the brain membrane, termed the falx major or falx cerebri. Two others, the lateral sinuses[3] occupy the transverse grooves, and their borders give attachment to the tentorium cerebelli, whilst the line extending from the spine downwards to the foramen magnum gives attachment to the falx minor or falx cerebelli, and generally encloses a short sinus[4] termed the occipital. By means of these grooves, the cerebral surface of the perpendicular portion of the bone becomes divided into four fossæ, the upper two of which are occupied by the posterior lobes of the cerebrum, and the lower two by the hemispheres of the cerebellum. Perforating the horizontal portion is a large almost circular space, the foramen magnum,[5] through which pass the spinal cord, its membranes and vessels, the vertebral vessels and spinal accessory nerves. On each side of the anterior margin of the foramen magnum is a small orifice, the anterior condyloid foramen,[6] for the transmission of the hypoglossal or ninth nerve, and more laterally, on each side of the same foramen, is a considerable projection of bone, the jugular process,[7] which is grooved[8] on its upper surface by a continuation of the lateral sinus already mentioned. This groove receives the posterior condyloid vein through a small foramen, and terminates in an enlarged space anteriorly, called the jugular fossa,[9] part of which only is formed by this bone, and the remainder by the temporal. From the anterior part of the foramen the basilar process[10] projects forwards, on the upper surface of which exists a deep longitudinal groove[11] or furrow, corresponding in position to the pons Varolii and medulla oblongata, and on each margin of this surface is a half groove completed by a corresponding half groove on the petrous portion of the temporal bone for the inferior petrosal sinus.

The *external surface* of the occiput presents an external prominence or spine[12], at the same level as the internal, which attaches the ligamentum nuchæ and from which a ridge, the crest of the occiput, extends downwards to the foramen magnum. Passing horizontally outwards from the spine are two superior curved lines,[13] each giving origin to the trapezius[14] internally, the occipito frontalis[15] in the middle third, and insertion to the sterno-cleido mastoid[16] externally, whilst the surface above the line is smooth and covered by the occipito frontalis muscle. From the centre of the crest two other lines, the inferior curved lines,[17] extend outwards, and each of these receives the insertion of the rectus capitis posticus minor[18] internally, rectus capitis posticus major[19] in the centre, and obliquus superior[20] externally. The space between the superior and inferior curved lines receives the insertion of the complexus muscle[21] internally, and the splenius capitis[22] externally. Below the inferior curved line

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is a rough portion, part of which attaches the posterior occipito atloidean ligament, and here on the horizontal part of the bone the foramen magnum[5] again comes into view. On each side of the foramen is situated a large eminence, the condyle[23] elongated, convex, approaching its fellow anteriorly, and smooth for articulation with the facet of the first cervical vertebra. Each has a foramen in front[6] and behind,[24] the anterior and posterior condyloid foramen respectively, the former transmitting the ninth nerve, the latter a small vein from without into the lateral sinus. At the inner and anterior part of each condyle is a roughening[25] for the attachment of the odontoid ligament. Altogether external to the condyle is the inferior surface of the jugular process, and into this is inserted the rectus capitis lateralis. The basilar process extends forwards in front of the foramen magnum, and is marked centrally by a small tubercle or spine[26] for the insertion of the superior constrictor muscle of the pharynx, and on each side of this a depression[27] for the insertion of the rectus capitis anticus major, and rectus capitis anticus minor.

The border of the occiput is deeply serrated, and by that portion[28] to [29] which extends from the highest point downwards to the lower border of the groove for the lateral sinus, articulates with the parietal bones, and forms with them the lambdoidal suture of the cranium. A continuation of the border[29] to [30] as far as the jugular process articulates with the mastoid portion of the temporal bone; and the rest is opposed without articulation to the petrous portion of the same bone, except the extremity of the basilar process,[31] which is incorporated with the body of the sphenoid bone, so that the articulations in all are with six bones, two parietal, two temporal, sphenoid, and the spinal column.

THE PARIETAL BONE. (*Plate* XII.)

The parietal bone is quadrilateral in shape, and forms part of the upper and lateral portions of the skull on each side. Its *cerebral surface* is necessarily concave; it is marked by depressions corresponding to the convolutions of the brain; and is also traversed by numerous fine grooves,[1] corresponding to the course of the middle meningeal artery and its branches, and commencing from the anterior inferior angle of the bone. Along the upper border runs a half groove,[2] which, being completed by a similar half groove in the other parietal bone, is continuous with the groove described on the occipital bone for the superior longitudinal sinus, but it is often very indistinct. Perforating the bone and entering this groove is the parietal foramen which transmits a vein from the scalp into the superior longitudinal sinus. In this part of the bone numerous small cavities[3] may be seen, which are occupied in the recent state by small bodies connected with the dura mater, termed Pacchionian glands or bodies. At the posterior inferior angle of this surface another groove,[4] often very short, runs obliquely forwards and downwards, and when applied to the occipital and temporal bones is found to complete the channel for the lateral sinus.

The *external surface* of the parietal bone is convex, and apparently of increased thickness and prominence at one point,[5] its centre of ossification. Below this the bone is crossed transversely by a curved ridge,[6] the temporal ridge to which a dense fascia, the temporal aponeurosis, is attached, and the remainder of the surface below the line gives origin to the temporal muscle[7] and forms a part of the temporal fossa.

The borders of the parietal bone are four in number, and of these the superior[8] is deeply serrated, and articulates with the corresponding border of the opposite parietal bone, to form the sagittal suture; and the anterior,[9] likewise deeply serrated, articulates with the frontal bone, to form the coronal suture. The posterior border,[10] also serrated, articulates with the occipital, to form the lambdoidal suture; and the inferior[11] is arched and serrated posteriorly, where it articulates with the mastoid portion of the temporal bone, but in its anterior three-fourths is thin and sharp, and adapted to the inner aspect of the margin of the squamous portion of the temporal bone. A small portion at the anterior inferior angle articulates with the great wing of the sphenoid bone, so that the articulations are in all with five bones, the opposite parietal, occipital, frontal, temporal, and sphenoid.

Of the four angles of the parietal bone, the anterior and posterior superior, are in the position of the anterior and posterior fontanelles of fœtal life; the anterior inferior angle is considerably prolonged downwards and forwards, and the posterior inferior is somewhat rounded in form.

THE TEMPORAL BONE. (*Plate* XIII.)

The temporal bone assists in forming the lateral wall and base of the skull. It may be described as possessing three distinct portions, namely, a squamous or thin flat plate, A, nearly vertical, a mastoid or nipple-like portion, B, projecting downwards from the posterior part, and a petrous portion, C, which extends inwards and forwards from the line of junction of the two preceding.

The *squamous portion*, A, on its cerebral surface is marked by the convolutions of the brain and by fine grooves corresponding to the course of the middle meningeal artery. Its outer surface, which is comparatively smooth, forms part of the temporal fossa, and gives origin to part of the temporal muscle,[1] whilst its circumference, which is much rounded, articulates with the lower border of the parietal bone by its upper part, and with the great wing of the sphenoid by its anterior part. Arising from the lower and anterior part, and from a continuation backwards in a line between the squamous and the mastoid portions, is a long but narrow projection, the zygomatic process.[2] This process at its commencement is hollowed upon its under surface, as though arising by two roots, together forming an arched cavity[3] in which the condyle of the lower jaw plays. The posterior root again appears to divide around the orifice of a canal, the external auditory meatus.[4] At the point of junction of the two roots the process presents a tubercle,[5] to which is attached the external lateral ligament of the lower jaw, and then extends forwards to articulate with the malar bone by a rough irregular and serrated termination. To the upper border of the process and the line which extends backwards the temporal aponeurosis[6] is attached, and from the lower border of the process anterior to the tubercle the masseter muscle[7] takes origin.

The glenoid cavity,[8] into the formation of which the zygoma enters so largely, does not entirely articulate with the lower jaw. A lower part, belonging rather to the petrous portion of the bone and formed by the auditory process[8] of that portion, is occupied by a process of the parotid salivary gland, and is separated from the true articular part of the cavity by a minute space, the Glasserian fissure,[9] through which pass the chorda tympani nerve, the laxator tympani muscle and tympanic vessels, and within which is attached the processus gracilis of the malleus bone of the ear.

The *mastoid portion*, B, is convex and rough upon its outer surface, where it is marked by the insertion of three muscles, sterno mastoid,[10] splenius capitis[11] and trachelo mastoid,[12] in order from above downwards, and by one or more foramina for the transmission of veins inwards to the lateral sinus. At the lower extremity of the mastoid portion, which from its shape and appearance is called the mastoid process, is a deep indentation, the digastric fossa,[13] from which arises the posterior belly of the digastric muscle; and internal to this the bone is often marked by a small groove for the passage of the occipital artery.[14]

The cerebral aspect is occupied chiefly by a broad groove, curving forwards and downwards, corresponding to the lateral sinus,[15] and receiving the internal orifice of the vascular canal, previously mentioned as perforating the substance of the bone. The rest of this surface receives the lateral hemisphere of the cerebellum.

The serrated margin articulates chiefly with the occipital bone, but by small portion at the upper extremity of the groove with the parietal.

The *petrous portion*, C, is that part of the temporal bone which extends into the base of the skull. It is pyramidal in form, projecting from the junction of the squamous and mastoid portions horizontally forwards and inwards. It possesses a base, an apex, anterior, posterior and inferior surfaces.

The base is chiefly incorporated with the rest of the bone, a large orifice, the meatus auditorius externus,[4] alone being visible. This foramen is situated immediately behind the glenoid cavity,[8] a thin plate of bone, termed the auditory process,[8] to which the cartilage of the ear is attached, forming at the same time the anterior wall of the one and the posterior wall of the other. It is the external opening of the auditory apparatus, and extends as a winding canal as far as the membrana tympani or middle ear.

The apex or internal extremity of the petrous portion is partly indented for adaptation to the basilar process of the occiput, and in front of this is excavated, so as to form a boundary to a foramen in the base of the skull, termed the foramen lacerem medium. It also exhibits the termination of the carotid canal.[16]

The anterior surface of the petrous portion faces forwards, upwards, and outwards, and assists in forming a space described as the middle fossa of the cranium. It presents close to the apex a depression corresponding to the position of the Gasserian ganglion[17] of the fifth nerve, and below this an extremely thin plate of bone, the roof of the carotid canal, but this is often broken away. More externally upon the surface, and near the lower margin, a groove runs outwards for some short distance and perforates the substance of the bone. This groove lodges the Vidian or large superficial petrosal nerve,[18] and having entered the bone at an opening termed the hiatus Fallopii, conducts it to the acqueductus Fallopii, a canal containing the facial nerve. Still further outwards there is a considerable elevation upon this surface due to the position of the superior semicircular canal[19] of the internal ear. The inferior margin of the anterior surface runs parallel to the border of the great wing of the sphenoid bone without articulation, and, where joining the squamous portion of the temporal bone, presents two small canals,[20] one above the other, and separated from each other by a thin septum, the processus cochleariformis. The superior of these canals transmits, and gives origin to some fibres of, the tensor tympani muscle, and the inferior is the osseous portion of the Eustachian tube.

The posterior surface faces backwards and inwards, and assists in forming the posterior cranial fossa. It presents an orifice of considerable size, the meatus auditorius internus,[21] in the depths of which may be seen numerous foramina. Of these, one, the aqueduct of Fallopius, is higher and far larger than the rest, for the transmission of the portio dura of the seventh nerve; whilst the rest are variable in size, for the passage of filaments of the auditory nerve, or portio mollis of the seventh, into the internal ear. Posterior to the meatus, a fine process of bone overhangs an elongated aperture, the external orifice of the aqueductus vestibuli,[22] along which a small vessel passes from the vestibule of the internal ear: and near the upper border of the surface there is generally a depression[23] which attaches the dura mater, and sometimes transmits a minute nutrient vessel. The border or edge separating the anterior from the posterior surface is markedly grooved by the superior petrosal sinus,[24] one of the venous channels in the dura mater.

The inferior surface belongs entirely to the under surface of the base of the cranium. It presents a large round orifice, the external opening of the carotid canal,[16] which, ascending a short distance, suddenly becomes horizontal in position, and running forwards and inwards terminates in the apex of the bone, as before mentioned. The roughened surface[25] between it and the apex gives origin to the levator palati and some fibres of the tensor tympani muscles. Immediately behind the carotid foramen are two depressions, one, the smaller, is partly visible upon the lower margin of the posterior surface, is of triangular form, and, narrowing as it deepens, terminates in a small canal, the aqueductus cochleæ[26] through which vessels pass to and from the cochlea. The other, external and much larger, is smooth and corresponds partly to a rough articular portion of the jugular process[28] of the occipital bone, and partly to a similar smooth depression[27] upon the jugular process, the union of the two bones completing an irregular space, termed the foramen lacerum posterius, or jugular foramen, where the jugular vein commences, and through which the three divisions of the eighth nerve, glosso pharyngeal, spinal accessory, and pneumogastric, leave the skull, and a small artery, the posterior meningeal, enters the skull. In the wall separating the jugular fossa from the carotid canal, is a small foramen for Jacobson's nerve,[29] the tympanic branch of the glosso pharyngeal. From the carotid canal and jugular fossa, a thin plate of bone extends towards the glenoid cavity: proceeding backwards and outwards, it partly ensheaths a conical spike of bone, the styloid process,[31] and receives the name of the vaginal plate[8] or process. It is here sometimes pierced by a small foramen for the passage of Arnold's auricular nerve,[30] and it afterwards becomes incorporated with the auditory process, which has been previously mentioned as forming the septum between the glenoid cavity and the meatus auditorius externus. The *styloid process*[31] projects downwards, forwards, and inwards, gradually lessening in size almost to a point. It is of variable length, and gives origin near its root to the stylo-pharyngeus muscle, by its central and outer part to the stylo-hyoid, and by its lower part to the stylo-glossus, whilst at its apex the stylo-hyoid ligament is attached, and in its whole length anteriorly the stylo-maxillary ligament. Behind the styloid process, between it and the mastoid process, is the termination of the aqueductus Fallopii, the stylo-mastoid foramen,[32] through which the facial nerve makes its exit from the skull, and a small stylo-mastoid artery enters.

The margin of the petrous portion which separates the inferior from the posterior surface, presents about the centre a small excavation, really the side view of the pyramidal fossa leading to the aqueductus cochleæ.[26] External to this it enters into the formation of the foramen lacerum posterius, and internal to it there is a half groove[33] (not often well marked), completed by a similar half upon the basilar process of the occipital bone, for the inferior petrosal sinus.

The articulations of the temporal bone are, with the occipital, parietal, sphenoid, malar, and, as a movable joint, with the inferior maxilla.

THE FRONTAL BONE. (*Plate* XIV.)

The frontal bone occupies the anterior part of the skull, and forms the forehead and the roof of the orbits.

Its *cerebral aspect* presents a horizontal portion, in which is a central deficiency[1] for adaptation to the horizontal plate of the ethmoid bone, and on each side of this space, a convex or elevated surface, marked by the convolutions of the brain, and contributing to form the anterior cranial fossa.[2] The rest of the bone ascends, arching upwards and backwards, according to the curve of the forehead; and in its median line projects the frontal crest,[3] a ridge composed of two lips which give attachment to the falx major of the dura mater. These lips slightly diverge at the lower part to form with the crista galli of the ethmoid bone a small cavity, the foramen cœcum,[4] or a fine canal for the transmission of a vein, and they broadly diverge above to form a groove for the superior longitudinal sinus. On each side of the sinus may be observed some few irregular cavities for Pacchionian bodies, and further outwards grooves for the passage of meningeal arteries.

The *external aspect*, like the internal, presents at its lower or horizontal portion the irregular ethmoidal deficiency,[1] and on each of this numerous imperfect cells,[5] which are completed by the ethmoid bone; and in front is the orifice of a large cell or space, the frontal sinus,[6] which extends upwards into the substance of the frontal bone, between its two tables. Between the cells, courses from without forwards and inwards the anterior ethmoidal groove[7], for the transmission of the nasal nerve and vessels from the ophthalmic, and behind this, more or less distinctly marked, the posterior ethmoidal groove[9] for an anterior meningeal artery from the ophthalmic. External to the cells is a large triangular smooth and concave fossa, the roof of the orbit[9], and this at its external angle is still more deeply hollowed for the reception of the lachrymal gland.[10] The posterior margin of the orbital surface articulates with the lesser wing of the sphenoid, but behind the outer part of this is a rough triangular surface for articulation with the great wing of the sphenoid. A well-defined smooth and thickened margin, the supra-orbital ridge[11] or arch, bounds the orbital surface in front, and extends downwards externally in the form of a thick rough projection, the external angular process[12] for articulation with the malar bone; whilst internally in the form of a less marked projection, is the internal angular process[13] which articulates with the lachrymal bone. The supra-orbital arch is perforated at its inner third by the supra-orbital foramen,[14] for the transmission of the supra-orbital nerve and vessels from within the orbit, and above the internal angular process it presents a small depression for the attachment of a fibro-cartilaginous pully,[15] over which turns the tendon of the superior oblique muscle of the globe of the eye. In the interval between the two internal angular processes, the bone is remarkably rough, and in the central line sends downwards a fine projection, the nasal spine,[16] which is often broken away in the disarticulation, and which occupies a position in the skull between the nasal bones and the perpendicular plate of the ethmoid. The upper extremities of the nasal bones articulate with the central part of the roughened notch[17] or interval, and the nasal process of the superior maxillary bones with the remainder.[18] Passing now to the vertical portion of the bone, two hollow elevations[19] curve upwards and outwards from the interval corresponding to the position of the frontal sinuses (to which spaces their prominence is due), and from them a slight elevation is continued outwards a little above and parallel to the supra-orbital ridge, which is termed the supraciliary ridge,[20] and which gives origin at its inner part to the supraciliary muscle or corrugator supercilii. From the external angular process a curved line[21] ascends upwards and backwards, cutting off a small hollowed surface below it, which enters into the formation of the temporal fossa, and gives origin to the temporal muscle, whilst the line itself is called the temporal ridge, and attaches the temporal aponeuroses. The surface contained between the two temporal ridges forms the forehead, being convex, high or low, according to its development in different individuals. It is also smooth and covered by the occipito frontalis muscle, and presents on each side a prominence due to the commencement of ossification, termed the frontal eminence.[22]

The serrated margin of the frontal bone articulates with the two parietal bones: the posterior margins of the orbital plates with the lesser wings of the sphenoid, and a rough triangular or quadrilateral portion external to them with the greater wings of the sphenoid: the inner margins of the orbital plates with the ethmoid: the frontal spine with the two nasal bones, and the perpendicular plate of the ethmoid: the rough interval in front of the spine with the two nasal and two superior maxillary bones: the internal angular processes with the lachrymal bones and the external angular processes with the malar bones.

The Sphenoid Bone. (*Plate* XV.)

The sphenoid bone is so situated in the skull that it articulates with all the bones of the cranium, and with some of those of the face. It is of complex arrangement, and may be described as possessing a body, from the sides of which pass off two greater[1] and two lesser[2] wings, and from its under surface two pterygoid processes.[3]

The *body* has six surfaces, bearing the same relation to each other as the sides of a cube.

The superior surface of the body resembles a Turkish saddle, sella turcica, that is, a deep central space with an elevation in front and behind. The space is called the pituitary fossa,[4] since it lodges a portion of the brain, the pituitary gland. The posterior elevation, or dorsum Ephippii,[5] is a quadrilateral plate of bone, the upper angles of which, projecting outwards, are termed the posterior clinoid processes,[6] and give attachment to the tentorium cerebelli of the dura mater. The anterior boundary of the fossa presents a rounded and smooth eminence, the olivary process,[7] due to the position of the optic commissure, which corresponds to this part; and below the process on each side there is often a small tubercle, the middle clinoid process, whilst the rest of the surface[8] above and in front of the olivary process is smooth, and is formed by the union of the two lesser wings; it is therefore covered by the anterior lobe of the cerebrum, and is often grooved in an antero-posterior direction by the olfactory nerves.

The inferior surface is bounded on each side by the root of the pterygoid process, and appears in the base of the skull. It presents a central projection, the rostrum,[9] which articulates with the vomer, and on each side of this small groove[10] completed as a canal by the sphenoidal process of the palate, and transmitting the pterygo-palatine vessels and nerve from before backwards.

The lateral surfaces attach the greater and lesser wings, the latter by two roots, and below the level of the pituitary fossa, they are grooved[11] deeply by the passage of the cavernous sinus and internal carotid artery.

The posterior surface[12] articulates with, or rather is ossified to, the termination of the basilar process of the occipital bone.

The anterior surface is very irregular. It exhibits a perpendicular lamina nearly central for articulation with the vertical plate of the ethmoid; and on each side of this is the orifice of large spaces occupying the body of the bone termed the sphenoidal cells[13] or sinuses, the apertures being bounded below by a fine bone, the sphenoidal turbinated,[14] which is at one time entirely distinct from the sphenoid.

The *great wings*[1] project from the sides of the body outwards and upwards, possessing a cerebral, an orbital, and an external surface and a circumference.

The cerebral surface[15] is concave and much curved upwards, forming a part of the middle fossa of the cranium, and slightly marked by the convolutions of the middle lobe of the cerebrum. At its most posterior and external part it is perforated by a small aperture, the foramen spinosum,[16] through which the middle meningeal artery enters the skull, and more internally by one much larger, the foramen ovale,[17] which transmits the third division of the fifth cranial nerve, or inferior maxillary, and the small meningeal artery, whilst in close contact with this there is occasionally a minute foramen of Vesalius for the passage of a small vein. More anteriorly, but close to the body, is an orifice opening forwards, the foramen rotundum,[18] for the transmission of the second division of the fifth cranial nerve or superior maxillary, and above this a large elongated open space, lying between the lesser wing above and the margin of the greater wing below, termed the foramen lacerum anterius,[19] or sphenoidal fissure, through which the third, fourth, first division of the fifth or ophthalmic, and the sixth nerves leave the skull, and the ophthalmic vein with filaments of the sympathetic nerve enter.

The orbital surface[20] looks forwards and inwards, it forms part of the outer wall of the orbit, and it is smooth, flattened, and of quadrilateral shape. By its anterior margin it articulates with the malar bone, and so completes the outer wall of the orbit; its posterior or inner margin is smooth, and bounds the sphenoïdal fissure below; its upper margin articulates with the orbital plate of the frontal bone; and its lower is smooth, entering into the formation of the spheno-maxillary fissure. The external surface[21] of the great wing is divided by a horizontal ridge into two parts, an upper and larger, concave from before backwards, looking outwards and forwards, and forming part of the temporal fossa, from which fibres of the temporal muscle arise; and a lower,[22] looking directly downwards, and forming part of the zygomatic fossa from which the external pterygoid muscle arises. The extreme posterior part of this surface sends downwards a projection of bone termed the spine[23] of the sphenoid, to which the internal lateral ligament of the lower jaw is attached, and from which the laxator tympani arises. Close to the spine is the foramen spinosum,[16] and to its inner side the foramen ovale,[17] seen from without.

The borders which separate the external from the cerebral surface, two in number, pass from the spine, one directly inwards towards the body, contiguous to, but not articulating with the petrous portion of the temporal bone, the other first forwards and then upwards, in a curved manner, articulating with the squamous portion of the temporal bone, and about one-third of an inch at its upper extremity with the anterior inferior angle of the parietal bone. At the highest part of, and supported by, the great wing, there is a rough triangular surface[24] for articulation with a similar surface behind the orbital plate of the frontal bone, and the three sides of this triangle are the superior marginal lines of the three surfaces of the great wing.

The *lesser wings*[2] are triangular in form, with their bases at the body, and their apices extending outwards in a tapering manner. The anterior border of each is serrated, and articulates with the horizontal plate of the ethmoid[25] by its inner part, and with the orbital plate of the frontal by its outer part. The posterior border occupies the Sylvian fissure of the brain, and its inner extremity, which is club-shaped, is termed the anterior clinoid process.[26] The upper surface, which is continuous with that of the body and with that of the opposite wing, is smooth, and contributes to the anterior fossa of the cranium; and the inferior surface, likewise smooth, forms the upper boundary of the foramen lacerum anterius, or sphenoidal fissure.[19] The base of the lesser wing, by which it is attached to the body, is composed of two roots, the upper of which is a thin but broad plate, which seems to extend across the body to the wing of the opposite side, whilst the lower[27] is a narrow spicule of bone, running from the side of the body upwards to the inferior surface of the wing. By means of the two roots a circular foramen[28] is formed, through which the optic nerve and the ophthalmic artery enter the orbit, and in front and around this foramen the muscles of the eyeball take origin.

The *pterygoid processes*[3] descend from the inferior surface of the body, at its junction with the great wing. A front view presents at the root of each the anterior orifice of the Vidian canal[29] through which the Vidian vessels and nerve are transmitted, and at the outer side of the canal the bone is slightly depressed for the reception of Meckel's ganglion; about the centre the process divides into two plates, and when articulated the interval is occupied by the tuberosity of the palate bone. A posterior view presents at the root the posterior orifice[30] of the Vidian canal, and immediately below this the process is composed of two plates. Of these the external pterygoid plate is far the larger, and by its outer surface,[31] which enters into the formation of the zygomatic fossa, gives origin to the external pterygoid muscle, and by its inner surface[32] to the internal pterygoid muscle.

The internal pterygoid plate[33] is narrow but long, and at its upper extremity on the outer side is marked by an elongated ovoid depression, the scaphoid fossa, from which arises the tensor or circumflexus palati muscle. At its lower extremity, on its posterior border, the superior constrictor muscle of the pharynx arises, and the extremity curves backwards in the form of a hook, the hamular process[34] around which the tendon of the tensor palati turns inwards towards the palate. The inner surface of this palate assists in forming the outer wall of the nose.

From the foregoing description the sphenoid bone has been seen to articulate by its great wing with the temporal, frontal, parietal, and malar bones, by its lesser wing with the frontal and ethmoid, by its body with the sphenoidal turbinated (afterwards united), the vomer and palate bones, and by its pterygoid processes with the palate bones.

THE ETHMOID BONE (*Plate* XIV.)

Presents for description a horizontal plate,[1] a perpendicular plate,[6] and a lateral or cellular mass.[7] The ethmoid bone fills up the space in the horizontal portion of the frontal bone by means of a thin lamina, its *horizontal plate*,[1] which being perforated for the transmission of the numerous filaments of the olfactory nerve, is also termed the cribriform plate. Along the cerebral surface of the cribriform plate a fine ridge extends from behind forwards, enlarging anteriorly into a strong triangular process, the crista galli,[2] and this process is usually surmounted by two small tubercles, which, fitting with the crest of the frontal bone, together form either a small canal for the passage of a vein, from the nose into the superior longitudinal sinus, or a shallow fossa, to which the name of foramen cœcum is applied. The posterior or curved margin of the crista attaches the falx major of the dura mater, and the anterior is rough for articulation with the frontal bone at the lower termination of its crest. On each side of the crista galli are seen the many foramina, from which the name of the plate is derived, and one of them, much larger and longer than the rest, situated at the anterior part and in contact with the crista, is termed the nasal fissure,[3] since it transmits the naso-lobular branch of the ophthalmic nerve from the skull into the nose. Towards the outer part of the cribriform plate, numerous half cells exist, and are completed by similar ones upon the lower surface of the horizontal portion of the frontal bone, along the margins of the ethmoid notch. Here also (seen only in a well-marked bone) are two foramina, or grooves between the cells, anterior[4] and posterior[5] ethmoidal, the former transmitting the naso-lobular branch of the ophthalmic nerve from the orbit into the skull, the latter an anterior meningeal branch from the ophthalmic artery.

The posterior margin of the cribriform plate articulates with the anterior borders of the lesser wings of the sphenoid, and their extension over the body of that bone.

From the inferior or nasal surface of the cribriform plate, which presents only the lower aspect of the olfactory foramina, the remaining parts of the bone descend, namely, from the central line antero posteriorly a thin lamina, the vertical plate,[6] and on each side of this, though not connected with it, an aggregation of cells, described as the lateral mass.

The *vertical plate*[6] assists largely in forming the septum of the nose; and in substance it is extremely thin, but somewhat thickened anteriorly, and slightly bent to one side. Its upper margin is connected with the cribriform plate in the continuous line with the crista galli, and commencing from the base of that process and terminating at the posterior margin of the horizontal plate, the circumference may be divided into four parts. The first part runs obliquely downwards and forwards, and articulates with the nasal bones and nasal spine of the frontal; the second downwards and backwards, and is connected with the septal cartilage of the nose; the third, which runs upwards and backwards, articulates with the superior border of the vomer; whilst the fourth is continuous with the central longitudinal lamina upon the body of the sphenoid bone, its slant depending upon fracture rather than upon disarticulation.

The *lateral mass*[7] presents upon its outer surface a quadrilateral smooth plate of bone, the os planum,[8] or orbital plate of the ethmoid, which assists in forming the inner wall of the orbit, and articulates with the lachrymal bone by its anterior margin, the latter bone completing the imperfect cells in front of the plate. The posterior margin of the os planum articulates with the sphenoid bone; the superior with the orbital plate of the frontal, where, when perfect, may be seen two orifices, the anterior[4] and posterior[5] ethmoidal foramina; and the lower margin articulates chiefly with the orbital surface of the superior maxillary bone, so that the half cells[9] below the os planum become completed: amidst these cells a process extends downwards and communicates with the inferior turbinated bone, the hamular process of ethmoid. A small portion,[10] however, of this margin, posteriorly together with one or more half cells, is attached to the ethmoidal surface of the anterior process of the palate bone.

At the anterior extremity of each lateral mass, there are often imperfect cells which are completed by the nasal process of the superior maxillary bone, and, at the posterior extremity, one or more large cells completed by the sphenoidal turbinated bones.

The cellular mass is composed of two distinct sets of cells, an anterior and a posterior, not connected with each other, and opening the posterior set into the superior meatus of the nose and the anterior set into the middle meatus. One of the anterior cells becoming united with the duct of the frontal sinus, produces a tube of funnel shape, termed the infundibulum.

From the internal surface of the lateral mass two thin and curled plates of bone curve inwards and downwards, their long diameters being from before backwards. They are well seen in a posterior inferior view of the ethmoid, and, from their peculiarly wrinkled or spongy appearance, are termed the turbinated or spongy bones.

The superior turbinated bone[11] is much the smaller of the two, and is situated on the posterior part of the ethmoid, not extending more forward than the centre, and it curves over a space described as the superior meatus[12] of the nose, in which may be seen the orifice of the posterior ethmoidal cells. The lower is called the middle turbinated[13] (since a third, the inferior turbinated, exists, but which is not a portion of the ethmoid), and it overhangs the middle meatus[14] of the nose, into which open the anterior ethmoidal cells and the infundibulum. This bone is larger in front than behind, and articulates posteriorly with a horizontal ridge upon the palate bone, and anteriorly with a continuation of that line forwards upon the nasal process of the superior maxilla. The ethmoid articulates with fifteen bones:—with the sphenoid by its perpendicular and horizontal plates, and also by the lateral masses; with the sphenoidal turbinated by the lateral masses; with the frontal bone by the horizontal plate and crista galli; also with the frontal spine by the perpendicular plate; with the palate bone by the orbital plate and by the middle turbinated; with the superior maxilla by the orbital plate; also with the nasal spine of the superior maxilla by its anterior cellular mass; with the lachrymal by the cellular mass in front of the orbital plate; with the inferior turbinated by a process from the cellular mass; with the nasal by its perpendicular plate; and with the vomer by its perpendicular plate.

THE BONES CONSTITUTING THE FACE.

The bones of the face are fourteen in number, of which the inferior maxilla and vomer are single; the rest being arranged in six pairs, superior maxillary, malar, palate, lachrymal, nasal and inferior turbinated.

THE SUPERIOR MAXILLARY BONE. (*Plate* XVI.)

The superior maxilla occupies one side of the face between the orbit and the mouth. It presents an internal aspect, entering into the formation of the nasal and oral cavities, and an external aspect which, in consequence of a considerable prominence, the malar process, exhibits three distinct surfaces, a facial, a zygomatic and an orbital.

The *internal aspect* enters more largely into the cavity of the nose than into that of the mouth, the two cavities being separated from each other by a horizontal plate of bone, the palatine process,[1] which is situated near the lower part of the surface, and which extends inwards in such manner that it becomes a portion of the floor of the nose and roof of the mouth.

The palatine process does not extend the entire length of the bone from before backwards, but leaves a considerable space[2] posteriorly which is occupied by the horizontal plate or palatine process of the palate bone. The upper or nasal surface of the palatine process is smooth and concave from side to side, but the lower or oral surface is arched in the shape of the roof of the mouth, and is much roughened for the attachment of an extremely thick glandulous mucous membrane, whilst it is also traversed by a groove from behind forwards for the passage of the posterior palatine vessels and nerves. The palatine process, which is continuous with the rest of the bone both externally and anteriorly, possesses only two free margins, a posterior which articulates with the horizontal plate of the palate bone, and an internal which articulates with the fellow of the opposite side, and which thickens considerably as it extends forwards and becomes incorporated with the alveolus. Anteriorly this margin is deeply grooved by a canal, the naso palatine,[3] running from the nose into the mouth for the transmission of the naso-palatine vessels and nerve, and its upper lip is elevated in the nasal cavity in the form of a crest,[5] which articulates with the vomer, and extends forwards beyond the nasal orifice as a fine and sharp point, the anterior nasal spine.[4]

That portion of the internal aspect of the superior maxilla below its palatine process corresponds to the roof of the mouth, and is rough for the attachment of the thick mucous membrane there found, and grooved by small vessels and nerves, branches chiefly of the posterior palatine.

That portion above the palatine process, belongs entirely to the outer wall of the nose.

The posterior half of this surface presents most conspicuously a large and irregular aperture leading into a cavity of considerable size, the antrum of Highmore,[6] and which aperture is almost entirely closed when the ethmoid inferior turbinated and palate bones are in position, a small orifice at its upper and anterior part alone remaining as a permanent communication between the space and the middle meatus of the nose. The antrum is somewhat pyramidal in shape, with its apex extending outwards into the malar process, so that its three walls correspond to the three surfaces upon the external aspect of the bone. Immediately above the aperture of the antrum are several half cells,[7] one of which, the most posterior, is completed by the anterior process of the palate bone, and the rest by the lower part of the lateral mass of the ethmoid. Below and behind the aperture the surface is rough, for articulation with the palate bone.[8] One part is particularly rough in a line continuous with the palatine process, where the horizontal plate of the palate bone articulates, and so completes the separation between the nose and mouth; but the surface is less rough behind, where the perpendicular plate of the palate bone articulates, or rather is adapted, overlapping some considerable portion of the aperture itself. In this latter region a groove[9] may be frequently observed, which being completed as a canal by the perpendicular plate of the palate, transmits the posterior palatine vessels and nerve; and often two such grooves exist. In front of the antrum a deep groove, the lachrymal duct,[10] descends from the orbit somewhat obliquely backwards and inwards, to the inferior meatus of the nose; and it is completed as a canal by the lachrymal and inferior turbinated bones; extending from the duct horizontally forwards to the anterior margin of the surface is a ridge for articulation with the inferior turbinated bone,[11] and the whole of the surface below the ridge is smooth and grooved, forming the outer wall of the inferior meatus,[12] or sinus of the nose. Above this line a portion of the bone ascends considerably higher than the rest, termed the *nasal process*,[13] the inner surface of which is continuous with the inner aspect of the bone, and it presents a second horizontal ridge,[14] running parallel with the first. The ridge articulates with the middle turbinated bone, and the surface between the two becomes the outer wall of the middle meatus[15] or sinus of the nose. Above the middle turbinated ridge, the surface forms part of the outer wall of the nose, and at its posterior portion presents one or two half cells,[16] completed by the ethmoid.

The external surface of the nasal process is continuous with the facial surface of the external aspect of the superior maxilla: it is comparatively smooth, and gives origin to the levator labii superioris alæque nasi.[17] The upper extremity or apex[18] is very rough, and often a little clubbed, articulating with the rough interval between the internal angular processes of the frontal bone. Of the borders of the nasal process, the anterior is thin, and articulates with the nasal bone. The posterior is thick, and breaks into two diverging ridges, one of which, the external, runs outwards to become continuous with the inferior orbital ridge, and presents a small tubercle, which may be taken as a guide to the lachrymal duct; whilst the other, or internal ridge,[19] articulates with the lachrymal bone, and thus encloses the lachrymal duct.

The *external aspect* of the superior maxillary bone has already been said to present three surfaces, due to the pyramidal prominence of the malar process.

The malar process is not composed of solid bone, but contains within its walls, which are comparatively thin, the spacious cavity, or antrum of Highmore, previously described. At the apex it is stout, rough, and indented, for articulation with the malar bone,[20] the roughness extending also from the apex inwards in the course of the inferior orbital ridge.

The anterior or facial surface presents near the upper margin the infra-orbital foramen,[21] or anterior orifice of a canal which transmits the infra-orbital nerve, a branch of the superior maxillary or second division of the fifth, and the infra-orbital artery. Above the foramen the levator labii superioris[22] takes origin, and below it the levator anguli oris.[23] Here the surface is markedly hollowed, and receives the name of the canine fossa, and close to the anterior border of the surface, a little below the level of the infra-orbital foramen, the compressor naris[24] arises. Approaching the lower margin of the same surface, a smaller concavity may be observed situated above the incisor teeth, termed the myrtiform fossa,[25] from which the depressor alæ nasi takes origin. The facial surface is excavated at its anterior border, in the position of the anterior orifice of the nose.

The posterior or zygomatic surface[26] is convex; it enters into the formation of the zygomatic fossa; and it is perforated by foramina for the posterior dental vessels and nerves in their passage to supply the molar teeth. Near the lower part there is a prominence, termed the tuberosity of the maxilla, due to the position of the wisdom tooth: and upon the surface, above the molar teeth, the buccinator muscle[27] takes its origin.

The superior or orbital surface forms the floor of the orbit and roof of the antrum. It is triangular in form and is smooth, and at its anterior margin elevated for the formation of the inferior orbital ridge, the outer half[20] of which is rough, and completed by the malar bone. Its external margin is bevelled and contributes to form the spheno-maxillary fissure;[28] and the internal[29] is irregular and articulates with three bones, the lachrymal in front, the os planum of the ethmoid in the centre, and the anterior process of the palate bone posteriorly. Across the orbital surface a canal,[30] the posterior part of which is usually uncovered, runs forward to terminate at the infra-orbital foramen, transmitting the infra-orbital nerve and artery. From the nerve and artery anterior dental twigs extend downwards through minute canals in the anterior wall of the antrum of Highmore to supply the incisor teeth. The inner angle of the surface is deficient, this being the position of the lachrymal duct,[31] and in the neighbourhood is a depression from which the inferior oblique muscle[32] of the eye arises.

The base, or lower, or alveolar border[33] of the superior maxilla, consists of a number of cavities, the alveoli, separated from each other, and surrounded, by thin laminæ of bone, the alveolar processes. The cavities are eight in number, corresponding to the teeth, and divided for the reception of their respective fangs; whilst the alveolar processes present innumerable vascular pores or foramina, which give them a spongy appearance.

The superior maxillary bone articulates with its fellow of the opposite side by the alveolar border and palatine process; with the vomer by the palatine process; with the palatine bone by palatine process and internal surface; with the ethmoid by the internal surface above the aperture of the antrum of Highmore, and by the nasal process; with the lachrymal bone by the same parts; with the inferior turbinated by the internal surface; with the nasal bone by nasal process; with the frontal bone by nasal process; and with the malar bone by the malar process.

THE MALAR BONE. (*Plate* XVII.)

The malar bone is of tabular form and quadrilateral. It enters largely into the composition of the orbit, and bounding the face laterally produces the high or low cheek of different individuals. It presents two surfaces and four borders.

The *external surface*[1] is convex, and is perforated by small canals for the passage of malar branches of nerve and vessels. Near the upper border it is covered by the orbicularis palpebrarum muscle,[2] and near the lower gives origin to two muscles,[3] zygomaticus major and zygomaticus minor, the latter being more anterior.

The *internal surface* enters into the formation of the temporal[4] and zygomatic[5] fossæ, for which purpose it is smooth and concave, but at its anterior extremity it becomes rough and uneven for articulation with the malar process of the superior maxilla.[6]

The four borders are named according to their position, orbital, maxillary, temporal, and zygomatic.

The *orbital* border[7] forms the outer, and also the chief part of the inferior margin of the orbit, and articulates at its upper extremity with the external angular process of the frontal bone,[8] and at its lower with the inferior orbital ridge of the superior maxilla. From it a thin plate extends backwards, which articulates with the orbital plate of the superior maxilla below[10 to 11] and with the orbital plate[9 to 10] of the sphenoid bone by its posterior margin, a small portion entering into the spheno-maxillary fissure (unless the orbital surface of the sphenoid articulates with the superior maxilla; a rare occurrence); and at the upper part it articulates with the orbital plate of the frontal bone.[8 to 9]

The *maxillary* border[15] is rough for articulation with the malar process, and the rough anterior margin of the orbital surface of the superior maxilla.

The *temporal* border[14] bounds the temporal fossa, and gives attachment to the temporal aponeurosis; whilst at its lower part it becomes continuous with the upper border of the zygomatic process of the temporal bone: a serrated angle or process of bone separates the zygomatic from the temporal border, and articulates with the anterior extremity of the zygomatic process of the temporal bone.

The *zygomatic* border[13] is continuous with the lower border of the zygomatic process of the temporal bone, and gives origin to fibres of the masseter muscle.

The malar bone articulates very largely with the superior maxilla by its internal surface, maxillary border, and orbital process; with the sphenoid by its orbital process; with the frontal by its orbital border and orbital process; and with the temporal by the serrated angle or process, sometimes called the zygomatic process of the malar.

THE PALATE BONE. (*Plate* XV.)

The palate bone occupies a position internal to the superior maxilla. It is composed of two plates, one horizontal, the other vertical, and a tuberosity which projects backwards, downwards, and outwards from their point of junction.

The *horizontal plate* is quadrilateral and it continues backwards the plane of the palatine process of the superior maxilla, with which it articulates by its anterior border,[1] thus completing the separation of the nose from the mouth. By its internal border[2] it articulates with the horizontal plate of the opposite palate bone, the union of the two forming a groove upon the upper aspect of the reception of the lower margin of the vomer.

The external border is incorporated with the perpendicular plate of the bone; and the posterior,[3] which is extremely thin, forms the boundary of the hard palate and gives attachment to the soft. This border is concave, and the inner point, uniting with that of the opposite side, projects backwards as a sharp process, the posterior nasal spine.[4]

Of the two surfaces of the horizontal plate, the superior or nasal is smooth and concave from side to side, the inferior or oral is rough and marked posteriorly by a transverse ridge[5] into which are inserted some fibres of the circumflexus or tensor palati muscle. At the outer extremity of the ridge appears one large foramen, often a second of smaller size, the orifices of the posterior palatine canals[6] for the transmission of vessels and nerves of the same name; whilst running forwards from the foramina is a groove which conducts them to the front of the hard palate.

The *vertical plate* is extremely thin and fragile and extends upwards at a right angle to the horizontal plate. Its external surface[7] is applied to the inner aspect of the superior maxilla with which it altogether articulates, and it is usually traversed by fine grooves in direction downwards and slightly forwards, which, when completed by similar grooves upon the maxilla, form the posterior palatine canals, the inferior orifices of which were seen on the under surface of the horizontal plate. The internal surface is marked by two horizontal ridges, one above the other, corresponding to those on the inner surface of the nasal process of the superior maxilla, and like them articulating the inferior[8] with the inferior turbinated bone and the superior with the middle,[9] while the surface below each ridge is concave from above downwards and enters into the formation of the outer wall of the inferior and middle meatus of the nose respectively. The vertical plate of the palate bone extends forwards at its anterior border, so as to assist in forming an inner wall to the antrum, thus materially lessening the orifice of that space.

From the upper border project two processes, an anterior, orbital,[10] and a posterior, sphenoidal[11], separated from each other by an interval or space, the spheno-palatine notch or foramen,[12] through which pass the spheno-palatine vessels and nerves.

The *anterior* or *orbital process*[10] is of variable size, containing within its substance one or even two small cells. In consequence of its enclosed position it articulates with other bones in three directions, and in addition assists in the formation of two spaces: thus possessing in all five surfaces. The articulating surfaces are, an anterior with the superior maxilla immediately below and behind the orbital surface of that bone, a posterior with the sphenoidal turbinated bone, and an internal with the ethmoid at the posterior inferior angle of the os planum. The surfaces entering into the spaces are the superior, triangular in form, at the extreme posterior part of the floor of the orbit; and the external in the spheno-maxillary fossa.

The *posterior* or *sphenoidal process*[11] is a thin plate of bone which curves inwards as it ascends to fit beneath the body of the sphenoid bone. It possesses an internal and an external surface, and two borders. The internal surface is smooth, and enters into the formation of the outer wall and roof of the nose. The external surface has upon it a slight perpendicular ridge, cutting off a small anterior portion, which is smooth and forms a part of the inner wall of the spheno-maxillary fossa. The rest of this surface behind the ridge articulates with the internal pterygoid plate and with the under surface of the body of the sphenoid, and upon the uppermost part of this surface is a half groove running from before backwards, which completes the pterygo palatine, through which run the nerve and vessels of the same name. Of the borders, the posterior is lost on the pterygoid plate and the anterior in part forms the posterior boundary of the spheno-palatine foramen and is in part lost beneath the sphenoidal turbinated bone.

The *tuberosity*[13] of the palate bone is a somewhat conical process projecting backwards, downwards, and outwards, from the angle of junction of the vertical with the horizontal plate. It enters between the two plates of the pterygoid process of the sphenoid bone, and presents on its posterior aspect a central smooth groove for the completion of the pterygoid fossa,[14] to the inner side of which is a second groove, deeper but rougher, for the reception of the internal pterygoid plate,[15] and to its outer side a rough margin for articulation with the external pterygoid plate.[16] The outer surface of the tuberosity is rough and uneven, for articulation with part of the tuberosity of the superior maxilla.

The palate bone articulates largely with the superior maxilla by its perpendicular plate and tuberosity; with the two turbinated bones by the inner surface of the perpendicular plate; with the sphenoid by its sphenoidal process and by its tuberosity; with the sphenoidal turbinated and ethmoid by the orbital process; with the opposite palate, and with the vomer by the internal margin of the horizontal plate.

THE LACHRYMAL BONE. (*Plate* XVII.)

The lachrymal bone, also termed the os unguis, from a supposed resemblance to a finger nail, is a small and thin bone, situated at the anterior part of the inner wall of the orbit. It possesses two surfaces and four borders.

The *external surface* looks into the orbit, and is divided by a perpendicular ridge into two portions, of which the anterior[1] and smaller is in the form of a groove, and assists in forming the lachrymal canal; whilst the posterior,[2] larger and flat, contributes to the inner wall of the orbit.

The *internal surface* is considerably hollowed in an angular manner, having the appearance of two laminæ of bone united together at an angle; the anterior[3] contributing to the middle meatus of the nose, and the posterior[4] closing in cells upon the lateral mass of the ethmoid. Frequently a half cell at the upper part of this surface completes a similar one upon the frontal bone.

Of the borders the *superior*[5 to 6] is short, but thick and serrated, and articulates with the frontal bone posterior to the junction of that bone with the nasal process of the superior maxilla. The *inferior*[7 to 8] is divided into two parts, an anterior, corresponding to the lachrymal groove, and extending downwards to articulate with the inferior turbinated bone, thus completing the lachrymal canal; and a posterior portion, which articulates with the orbital plate of the superior maxilla. The *posterior border*[5 to 8] articulates with the os planum of the ethmoid, and the *anterior border*[6 to 7] with the posterior margin of the nasal process of the superior maxillary bone.

THE NASAL BONE. (*Plate* XVII.)

The nasal bones are two small quadrilateral bones, which, when united together, form the bridge of the nose, and for that purpose are placed in an oblique position. Each presents two surfaces and four borders.

The *anterior* or *external surface*[1] is smooth and concave from above downwards. It is covered by the pyramidalis nasi muscle, and perforated by one or more vascular foramina.

. The *nasal surface*[2] is convex, and, by a small portion near the upper extremity of the bone, assists in closing the frontal sinus: the remainder enters into the roof of the nose, and is frequently marked by a longitudinal groove, along which the naso-lobular nerve courses to the extremity of the nose. Of the borders the *superior*[3] is small, but thick and stunted, and is serrated for articulation with the central rough notch of the frontal bone. The *inferior*[4] is thin, curved, or irregular, and is connected with the lateral cartilage of the nose.

The *anterior* or *internal* border[5] is very thick and flat, perfectly straight and central, and, when compared with the external border, tolerably smooth; it articulates with its fellow bone, and posteriorly is in contact with the nasal spine of the frontal and perpendicular plate of ethmoid. The *external border*[6] is longer and much thinner than the internal; it slants obliquely outward, and it is rough for articulation with the anterior border of the nasal process of the superior maxilla.

THE INFERIOR TURBINATED OR SPONGY BONE. (*Plate* XVII.)

The inferior turbinated bone is of a coiled up and spongy appearance; it is contained within the cavity of the nose, and over-roofs a space described as the inferior meatus. It presents an *external surface*, concave, and an *internal*[1] *surface*, convex, spongy, and grooved by blood-vessels. The *anterior extremity*[2] of the bone is thin and rounded, but the *posterior*[3] projects backwards in the form of a point. The *inferior border* is thick and spongy, and lies free within the cavity of the nose, but the superior border is the part which holds the bone in position by its numerous articulations. Most anteriorly[3 to 4] this border is attached to a horizontal ridge, situated at the base of the nasal process of the superior maxilla; behind this a triangular process[4'] ascends to meet the lachrymal bone, and assists in forming the lachrymal canal; still more posteriorly[5 to 6] a thin plate of bone curls over and descends upon the inner wall of the antrum of Highmore, by which a communication also takes place with the lateral mass of the ethmoid bone; and, lastly, behind this a thin edge[6 to 8] is connected with the inferior turbinate ridge of the perpendicular plate of the palate bone.

THE VOMER. (*Plate* XVII.)

The vomer is the thin perpendicular plate which contributes so materially to the septum of the nose. Its name signifies a ploughshare. It is quadrilateral in form, with an expansion upon its upper border. The two surfaces of the bone resemble each other, with the exception that one, usually the left, is convex, and the other concave, owing to which the bone is more prominent in the one than in the other nasal cavity. Each then is grooved by the passage of blood-vessels and nerves, and one groove[1], larger and deeper than the rest, extends downwards and forwards, transmitting the naso-palatine nerve.

The *superior border*[2 to 3] is short but thickened, and spreads out laterally in the form of two alæ, which, when the bone is articulated, embrace the rostrum of the sphenoid bone, and extend as far as the sphenoidal process of the palate bone.

The *inferior border*[4 to 5] fits into the groove formed by the junction of the two palatine processes of the superior maxillary bones, and the two horizontal plates of the palate bones.

The *posterior border*[3 to 4] is sharp and almost perpendicular; it separates the posterior orifices of the nares one from the other.

The *anterior border*[2 to 5] has a very oblique direction, downwards and forwards, and usually presents a separation of the two surfaces of the bone, thus producing a space or groove for the reception of the perpendicular plate of the ethmoid, and in front for the septal cartilage of the nose.

THE INFERIOR MAXILLA. (*Plate* XVI.)

The entire lower jaw is one bone, the inferior maxilla, and this may be described as possessing an arched body, or central portion, from the extremities of which ascend two quadrilateral appendages, the rami.

The body is curved upon itself, so as to present an anterior convex and a posterior concave surface, and an upper and lower border.

The convex surface is marked in the centre by a vertical prominence, the symphysis[1] or original separation of the bone into two parts, and on each side of this, by a slight depression, the mental fossa,[2] from which arises the levator menti muscle: still more externally, about the level of the second bicuspid tooth, a foramen of some considerable size, the mental foramen,[3] extends into the substance of the bone to the dental canal, and transmits to the surface mental branches of nerve and vessels derived from the inferior dental. An oblique line,[4] more or less distinctly marked, extends from or near the symphysis backwards and upwards to the anterior border of the ramus. It is designated the external oblique line, and gives origin above to the quadratus menti,[5] or depressor labii inferioris, and behind this to the depressor anguli oris,[6] receiving below the insertion of the platysma myoides. Between the oblique line and the molar teeth the buccinator muscle[7] arises.

The concave surface presents a central perpendicular marking, either elevated or depressed, which may be recognised as the symphysis,[8] and at its lower point an elevation composed of four tubercles,[9] arranged in two pairs, for the origin, the upper of the genio-hyo-glossus, and the lower of the genio-hyoid muscles; whilst below the tubercles, encroaching on the lower border are two fossæ, one on each side, for the origin of the anterior belly of the digastric muscle.[10] A depression of considerable extent, though shallow, exists on each side of the tubercles in the position of the sublingual gland, hence termed the sublingual fossa;[11] and from this an elevated ridge, the internal oblique line,[12] or mylo-hyoid ridge, extends upwards and backwards towards the ramus. This line gives origin to the mylo-hyoid muscle, and at its posterior extremity, also to fibres of the superior constrictor muscle of pharynx.[13] The surface below the line is in contact with the submaxillary gland, and from that circumstance is termed the submaxillary fossa.[14] The upper border of the bone is composed of deep cavities, sixteen in number, the alveolar spaces, separated from each other, and surrounded by fine laminæ, the alveolar processes, and perforated by innumerable vascular foramina. The spaces are adapted in size and form to the respective teeth by which they are occupied. The lower border is smooth, rounded, and subcutaneous in the whole of its extent; and at its junction with the ramus it is grooved by the facial artery[16] in its passage on to the cheek.

The ramus extends upwards from the body at an angle, the degree of which varies with the age of the individual, being very obtuse in early life, but gradually approaching a right angle towards adult age.

The external surface of the ramus is continuous with the convex surface of the body. It is somewhat rough in appearance, and receives upon its lower three-fourths the insertion of a large muscle of mastication, the masseter:[15] and above this and near the posterior part the external lateral ligament of the lower jaw is attached.

The internal surface of the ramus presents near the centre the large orifice of the inferior dental canal,[17] through which the inferior dental vessels and nerve pass for the supply of the lower teeth. A small but distinct groove,[18] extends downwards from the foramen, to conduct from the vessels and nerve a small branch, the mylo-hyoid, to supply the muscle of the same name and the anterior belly of the digastric. The anterior border of the foramen is formed by a sharp point of bone, the vaginal process,[19] to which the internal lateral ligament of the lower jaw is attached; and below the foramen the surface is rough for the insertion of the internal pterygoid muscle.[20]

The posterior border of the ramus is smooth and rounded, giving attachment to the stylo-maxillary ligament.[21]

From the superior border ascend two processes, the posterior for articulation, termed the condyle,[22] and the anterior or coronoid process,[24] separated from each other by an interspace, the sigmoid notch.[26]

The condyle[22] is a convex articulating process, adapted to the anterior half of the glenoid cavity of the temporal bone, and is therefore longer from side to side than from before backwards. As the condyloid process verges into the ramus it contracts considerably, so that the articulating portion becomes supported upon a neck, which it overhangs in front so as to produce a fossa, into which is inserted the external pterygoid muscle.[23]

The coronoid process is of triangular form, with the apex directed upwards. Upon its external surface it is flat and smooth, but internally it is rough for the insertion of the temporal muscle;[25] and its anterior margin divides into two ridges, one passing each side of the teeth.

The sigmoid notch[26] or space between the two processes simply transmits the masseteric vessels and nerve, for the supply of the masseter muscle.

The inferior maxillary bone articulates with the two temporal bones only, and the joint is one of the few that possess an inter-articular fibro-cartilage.

THE SKULL EXAMINED AS A WHOLE.

The vault or arched roof of the skull comprises portions of the frontal, of the parietal, and of the occipital bones. It is of an arched form, and upon its *exterior surface* exhibits along its centre, from before backwards, the sagittal suture, or union of the parietal bones, at the anterior extremity of which, and at right angles to it, is the coronal suture or junction of the frontal with the parietal bones, and at the posterior extremity the lambdoidal suture, passing obliquely downwards upon each side between the occipital and parietal bones. At the two extremities of the sagittal suture are found, in the fœtus, the anterior and posterior fontanelles respectively.

Wormian bones are found more or less frequently in the various sutures of the cranium, and consist of small but distinct bones ossified from a separate and special point.

The *interior surface* of the vault presents the same sutures, and, in elderly subjects, scattered here and there a variable number of depressions, occupied by small bodies, described as Pacchionian glands.

This surface is impressed by the convolutions of the brain, and grooved by the middle meningeal artery, and in its median line is a slight depression corresponding to the superior longitudinal sinus, and sometimes perforated near the posterior part by the parietal foramina.

THE INFERIOR REGION. (*Plate* XVIII.)

The inferior region is of large extent, and includes all the points within a quadrilateral space, the diameters of which run, one from the incisor teeth to the occipital protuberance, and the other from one mastoid process to the other. In the front part, surrounded by the teeth of the upper jaw, is the roof of the mouth,[1] composed of the palatine processes of the superior maxillary bones, and behind these the horizontal plates of the palate bones, which unite together in the median line.

The median suture presents at its anterior extremity the orifice of the anterior palatine canal,[2] for the transmission of a nerve and vessels of the same name, and at its posterior extremity a sharp process, the posterior nasal spine. The horizontal plates of the palate bones are joined to the maxilla by what is termed the transverse suture, and are marked by a transverse ridge, at the outer extremity of which are one or more foramina for the posterior palatine vessels and nerves.[3]

Behind the palate the posterior orifices of the nares,[4] come into view, separated from each other by the free margin of the vomer, and bounded above by the body of the sphenoid, ala of vomer and sphenoidal process of the palate bone, together forming the pterygo-palatine canal; below by the horizontal plate of the palate bone; and externally by the pterygoid processes.

The pterygoid process consists of two plates: the internal,[5] is small and thin; it is curved and prolonged at its inferior extremity, the hamular process, around which turns the tensor or circumflexus palati muscle, and it is marked above by a depression, the scaphoid fossa, for the origin of the same muscle. The external plate,[6] the larger, gives origin by its internal surface to the internal pterygoid muscle; and by its outer surface, which enters into the zygomatic fossa, to the external pterygoid.

The space between the two plates, known as the pterygoid fossa, is completed by the tuberosity of the palate bone. In the root of the pterygoid process is the posterior orifice of the Vidian canal, often difficult to be seen in this view. External to the pterygoid process, in the great wing of the sphenoid bone, is the foramen ovale,[7] for the transmission of the third division of the fifth nerve, and the small meningeal artery; next to this, the foramen spinosum,[8] through which the middle meningeal artery enters the skull, and still more externally the spine[9] of the sphenoid bone, which attaches the internal lateral ligament of the lower jaw and the laxator tympani muscle.

Commencing again in the median line we come upon the petrous portion of the temporal bone fitting into the angle between the basilar process and the sphenoid bone. This does not however articulate, but leaves a space, the foramen lacerum medium,[11] occupied in the recent state by a fibro-cartilage. Following now the temporal bone from within outwards, the points to notice are, first, the rough surface for the origin of the levator palati and tensor tympani muscles,[12] next, a circular foramen, the inferior orifice of the carotid canal,[13] and behind this, formed partly by the petrous portion of the temporal, partly by the occipital bone, the jugular foramen or foramina lacerum posterius,[14] through which the jugular vein and the three divisions of the eighth nerve leave the skull. Moreover, behind the carotid canal is a conical fossa, contracting in its depths into a little canal, the aqueductus cochleæ,[15] and in the wall which separates the carotid canal from the jugular fossa, a minute foramen for Jacobson's nerve.[16] Next in order, the vaginal process,[17] sometimes perforated by Arnold's foramen, proceeds outwards and bifurcating encloses the styloid process; whilst external to this is the stylo-mastoid foramen,[18] or termination of the aqueductus Fallopii, the passage of the portio dura of the seventh nerve. This aspect of the mastoid process is deeply grooved by the digastric fossa[19] for the origin of the posterior belly of the digastric muscle, and running internal and parallel to the fossa is a small groove, more or less marked, in which lies the occipital artery. In front of the vaginal process is the glenoid cavity,[21] separated into two parts by the Glasserian fissure,[20] an anterior, occupied by the condyle of the lower jaw, and a posterior, occupied by a process of the parotid gland. The fissure itself gives exit to the chorda tympani nerve, the laxator tympani muscle and a tympanic artery, and contains the processus gracilis of the malleus. In the angle between the squamous and petrous portions, a bristle may be passed into two canals, one above the other, the lower being the Eustachian tube, the upper, the canal for the passage of the tensor tympani muscle. Again, returning to the median line, may be seen the basilar process[10] of the occipital bone, which gives insertion by a tubercle (its spine) to the superior constrictor muscle of the pharynx, and, by a depression behind the spine, to the rectus capitis anticus major and minor muscles of the right and left sides, and behind the basilar process the large aperture, the foramen magnum,[22] through which the spinal cord and its vessels leave the skull, and the vertebral arteries and spinal accessory nerves enter it. On each side of the foramen is the condyle of the occiput,[23] convex, elongated in shape, and approaching its fellow at its anterior extremity, and rough internally for the attachment of the check ligaments; in front and behind it are the anterior[24] and posterior[25] condyloid foramina, and some little distance to its outer side is the jugular process[26] of the occiput, into which the rectus capitis lateralis is inserted. Behind the foramen magnum the crest of the occiput ascends towards the external protuberance of the same bone, and upon each side of it pass off the inferior[27] and superior[28] curved lines, the former receiving the insertion of the rectus capitis posticus minor and major muscles, as well as the superior oblique; the latter giving origin to the trapezius and the occipito frontalis, and insertion to the sterno-mastoid, whilst the interval or space between the two lines gives insertion to the complexus[29] and splenius capitis.[30]

THE CRANIAL FOSSÆ. (*Plate* XVIII.)

The cerebral aspect of the base of the skull, similar upon the two sides, presents two projecting borders, dividing the whole into three fossæ, each of which receives a separate portion of the brain substance, namely, the anterior and middle fossæ, the corresponding lobes of the cerebrum, and the posterior fossa, the lateral hemisphere of the cerebellum.

The *anterior fossa* is formed chiefly by the upper surface of the orbital plate of the frontal bone, having a portion of the horizontal plate of the ethmoid bone internally, and the lesser wing of the sphenoid bone posteriorly. It is therefore elevated, convex, and marked by the cerebral convolutions, and also by fine grooves for meningeal arteries. The fossa is separated from its fellow of the opposite side by the crista galli,[1] which gives attachment to the falx major, and forms at its anterior extremity a small aperture, the orifice of the foramen cœcum.[2] At the side of the crista galli is the cribriform plate[3] of the ethmoid, with its numerous foramina for the transmission of the divisions of the olfactory nerve, for the trunk of which there is frequently a groove extending backwards over the body of the sphenoid bone. One of the apertures,[4] close to the crista and near its anterior extremity, is of a fissure-like form, and transmits the naso-lobular branch of the ophthalmic nerve into the cavity of the nose. At the junction of the ethmoid with the orbital plate are two foramina,[5] the orifices of the anterior and posterior ethmoidal grooves, the former of which transmits the nerve just mentioned from the orbit into the skull, and the latter a small meningeal artery in the same direction.

The *middle fossæ* of the two sides communicate with each other across the pituitary fossa[7] on the body of the sphenoid bone; there is therefore a portion in the central line which may be said either to belong to both fossæ or to neither, namely, the pituitary fossa or sella turcica. This part is bounded posteriorly by the dorsum Ephipii,[8] anteriorly by the olivary process,[9] surmounted by the optic groove, which extends forwards and outwards on each side to the optic foramen; and laterally by the groove[10] for the cavernous sinus and internal carotid artery.

The middle fossa is formed by the greater wing of the sphenoid bone, and by the petrous and squamous portions of the temporal bone, upon each of which the distinctive points must be separately enumerated.

On the anterior wall, between the greater and lesser wing of the sphenoid bone, is the foramen lacerum anterius,[11] or sphenoidal fissure, opening into the orbit, and transmitting the third, fourth, first division of fifth, and the sixth nerves and the ophthalmic vein. Below the inner extremity of the sphenoidal fissure is the foramen rotundum,[12] through which the superior maxillary or second division of the fifth nerve leaves the skull; and behind and external to this the foramen ovale,[13] transmitting the inferior maxillary or third division of the fifth nerve and a small meningeal artery, the latter into the skull. External to the foramen ovale the middle meningeal artery enters the skull through the foramen spinosum.[14]

The posterior part of the middle fossa is formed by the anterior surface of the petrous portion of the temporal bone, at the inner extremity of which is the foramen lacerum medium,[15] an aperture leading through the base of the skull, but occupied only by a fibro-cartilage. Running outwards along the surface is the groove which conducts the Vidian nerve,[16] and at its outer extremity the hiatus Fallopii, through which foramen the same nerve enters the substance of the bone. Near the upper margin at the inner extremity, is the depression or fossa upon which rests the Gasserian ganglion[17] of the fifth nerve, and at the outer extremity an elevation due to the prominence of the superior semicircular canal.[18]

The outer wall of the fossa, formed by the squamous portion of the temporal bone, presents the markings of the convolutions of the brain and grooves formed by the passage of the middle meningeal artery.

The *posterior fossa* is formed by the occipital bone, by the mastoid portion of the temporal bone, and by the posterior surface of the petrous portion of the temporal bone. The extent of the fossa upon the occipital bone is bounded by the groove for the lateral sinus,[19] the borders of which give attachment to the tentorium cerebelli: within the groove there is often a canal for the transmission of a mastoid vein,[20] and below the groove is the depth of the fossa which receives the hemisphere of the cerebellum. More anteriorly and nearer the central line of the skull is the large aperture of the foramen magnum,[21] and in front of it a small orifice, the anterior condyloid foramen,[22] through which the ninth nerve leaves the skull. Proceeding from the foramen magnum to the sphenoid bone is the basilar process[23] of the occipital bone, grooved longitudinally for the medulla oblongata, and having a partial groove along the outer border for the inferior petrosal sinus.[24] At the line of junction of the petrous portion of the temporal bone with the occipital is a large aperture, the foramen lacerum posterius,[25] through which the lateral sinus opens into the internal jugular vein, and the three divisions of the eighth nerve leave the skull.

The posterior surface of the petrous portion exhibits along its superior margin the groove for the superior petrosal sinus,[26] and along its inferior margin, internal to the foramen lacerum posterius, a half groove completed by the basilar process of the occipital bone for the inferior petrosal sinus.[24] About the centre of the surface is the meatus auditorius internus,[27] which is occupied by the seventh cranial nerve, and in its depth presents one larger orifice at the upper part, the aqueductus Fallopii, for the portio dura or facial division of the same nerve, and several smaller foramina at the lower part for the filaments of the portio mollis or auditory division of the seventh nerve; and some little distance external to the meatus is a small orifice overlapped by a fine sheath of bone, the aqueductus vestibuli.[28]

THE TEMPORAL FOSSA.

The temporal fossa is the space occupied almost entirely by the temporal muscle. It extends from the temporal ridge on the frontal and parietal bones downwards to the level of the zygomatic process, where it becomes continuous with the zygomatic fossa. It is bounded by the frontal, great wing of the sphenoid, parietal and temporal bones; and anteriorly by the malar bone.

THE ZYGOMATIC FOSSA.

The zygomatic fossa is bounded in front by the superior maxillary bone, in which are seen the foramina for the posterior dental vessels and nerves; externally by the malar bone and the zygoma; internally by the external pterygoid plate, from which the external pterygoid muscle arises. It is continuous with the temporal fossa above, from which it is separated by the zygoma and a horizontal ridge upon the greater wing of the sphenoid; it is continuous internally with the spheno-maxillary fossa, with which it communicates by means of the pterygo-maxillary fissure; and it is connected to the orbit by the outer part of the orbital fissure.

THE SPHENO-MAXILLARY FOSSA.

The spheno-maxillary fossa is a small pyramidal space, base upwards, between the pterygoid process of the sphenoid and the posterior part of the superior maxillary bone. Its posterior boundary is the pterygoid process, and upon it three orifices open into the fossa, the foramen rotundum superiorly for the transmission of the superior maxillary nerve, the Vidian and pterygo-palatine canals below for the passage of vessels and nerves of the same name, the mouth of the former being also the position of Meckel's ganglion. The internal boundary is the perpendicular plate of the palate bone, which, by dividing at its summit into two processes, produces between them a notch or foramen (spheno-palatine) connecting this fossa with the nose. At the lowermost part of the space, its extreme apex, are the upper orifices of the posterior palatine canals. The fossa is open at its outer aspect, presenting a large triangular aperture, the pterygo-maxillary fissure, through which the internal maxillary artery passes, and again it communicates with the orbit by a similar aperture, the orbital fissure.

THE ORBITS. (*Plate* XIX.)

The orbits are two large spaces for the eyes, situated beneath the frontal bone, and occupying a large portion of the face. Each is pyramidal in form, is composed of four walls, and has its apex inwards, and the line of its axis passing obliquely backwards and inwards, whilst its base is open to the surface and surrounded by a very strong margin of compact bone. The *roof* is formed by the orbital plate,[1] of the frontal bone, and posteriorly by a part of the lesser wing[2] of the sphenoid. It is concave in every direction, and at its external anterior portion is still more markedly so for the production of a fossa[3] for the lachrymal gland. At the junction of the roof with the internal wall two foramina pass from the orbit into the skull, of which the anterior[4] transmits the nasal nerve and vessels from the ophthalmic; and the posterior,[5] an ethmoidal artery, also from the ophthalmic. The superior margin of the orbit is perforated near its inner third by the supra-orbital foramen,[6] through which the supra-orbital artery and nerve pass to the forehead, and still more internally is a depression for the attachment of the cartilaginous pulley for the superior oblique muscle.[7]

The *floor* is formed by the orbital plate of the superior maxilla,[8] by the malar bone[9] uniting with it in front, and quite posteriorly by a very small portion of the palate bone, the orbital process.[10] The inferior oblique muscle[11] takes origin from the anterior and internal part, and along the centre runs from behind forwards the infra-orbital canal,[12] for the passage of the infra-orbital nerve and vessels.

The *internal wall* is formed by the nasal process of the superior maxilla,[13] the lachrymal,[14] the orbital plate of the ethmoid[15] and a small portion of the body of the sphenoid, in order from before backwards. Between the lachrymal bone and the nasal process of the superior maxilla, by which bones it is formed, the lachrymal canal[16] leaves the orbit to open into the inferior meatus of the nose. The anterior[4] and posterior[5] ethmoidal or orbital foramina, already described are connected with this wall equally with the roof.

The *external wall* is formed by the malar bone[9] in front and the orbital plate of the sphenoid[17] behind and is marked by small foramina, through which twigs of nerve pass to the the cheek. Between this wall and the floor is a space of considerable size, the spheno-maxillary or orbital fissure,[18] connecting the orbital with the zygomatic and spheno-maxillary fossæ.

The Apex. In the depth of the orbit may be seen two spaces, one the optic foramen,[19] internal and above, the other the sphenoidal fissure,[20] or foramen lacerum anterius. The optic foramen[19] is the interval between the two roots of the lesser wing of the sphenoid, is of somewhat circular form, and transmits the optic nerve and ophthalmic artery from the cavity of the cranium into the orbit. The sphenoidal fissure,[20] large internally but tapering as it runs outwards and upwards, is the space between the lesser wing and the orbital plate of the sphenoid bone, and transmits the third, fourth, ophthalmic division of the fifth, and the sixth nerves and ophthalmic vein.

THE NASAL FOSSÆ. (*Plate* XIX.)

The nose is divided by a perpendicular septum into two cavities, each of which has a roof, a floor, an external and an internal wall, and an anterior and posterior orifice.

The *roof* slants considerably at its anterior part, where it is formed by the nasal bone[1] and part of the nasal spine of the frontal. Behind this it becomes horizontal, consisting of the cribriform plate of the ethmoid,[2] in which are the numerous foramina for filaments of the olfactory nerve, and still more posteriorly it again decends, being composed of the under surface of the body of the sphenoid[3] and sphenoidal process of the palate bone, and the ala of the vomer.

The *floor*[4] is slightly concave from side to side, and is formed by the palatine process of the superior maxilla and the horizontal plate of the palate bone. From the anterior part near the septum the anterior palatine or naso-palatine canal[5] leaves the nose to conduct vessels and nerves of the same name to the mouth.

The *internal wall* or septum of the nose, not seen in the plate, is formed near the floor by an elevated crest, the junction of the superior maxillary and palate bones of opposite sides; and fitting into a groove on the crest is the vomer, which usually curves somewhat into the left side, rendering that cavity smaller than the right. Above the vomer is the perpendicular plate of the ethmoid, and at its anterior margin, between it and the nasal bones, is the spine of the frontal bone.

The *external wall* is formed by the following parts, which are in order from before backwards: the superior maxilla, with its nasal process,[6] the nasal surface of the lachrymal; the cellular mass of the ethmoid; the perpendicular plate of the palate bone,[7] and the internal pterygoid plate of the sphenoid.[8] Attached partly to this wall, and extending inwards into the cavity of the nose, are the three turbinated or spongy bones, superior,[9] middle,[10] and inferior,[11] respectively overlapping three spaces, the superior, middle and inferior sinus or meatus of the nose. Each meatus passes horizontally from before backwards, and receives the openings of neighbouring spaces. The superior meatus is overlapped by the superior turbinated bone, the smallest of the three placed far back in the cavity, and it receives the orifice of the posterior ethmoidal cells. The spheno-palatine foramen[12] and sphenoidal cells[13] are also described as entering into this sinus, though neither of them is under cover of the turbinated bone. The middle meatus receives the orifices of the anterior ethmoidal cells, a large duct termed the infundibulum, common to the frontal sinus[16] and to one or more anterior ethmoidal cells, and the orifice of the antrum. The inferior meatus receives one orifice only, that of the lachrymal duct, a canal extending from the orbit to the nose, and formed by the nasal process of the superior maxilla, the lachrymal bone and the inferior turbinated.

The *posterior nares*, or posterior orifices of the nose, are two large spaces opening into the pharynx, oval in form with the long diameter vertical, placed side by side and separated from each other by the posterior free margin of the vomer. The outer margin of each is formed by the internal pterygoid plate;[8] the inner by the vomer; the lower by the free border of the horizontal plate of the palate bone, which projects internally as a fine process, the posterior nasal spine; and the upper by the lower surface of the body of the sphenoid,[8] with the ala of the vomer and the sphenoidal process of the palate bone projecting upon it. This boundary is traversed from before backwards by the pterygo-palatine canal.

The *anterior orifice* of the nose is not so perfectly divided by a septum, though the septum can be seen by looking into the cavity. The entire aperture is of irregular form, longer from above downwards than from side to side, and bounded laterally by the nasal and superior maxillary bones, which latter, at their junction at the lowest point of the orifice, project in the form of a small sharp process, namely, the anterior nasal spine.

THE ORGAN OF HEARING. (*Plate* XX.)

The osseous portion of the organ of hearing is composed of three parts, the external auditory canal, the middle ear or tympanum, and the internal ear or labyrinth.

The external auditory canal is a little less than an inch in length, and extends from the external orifice into the substance of the petrous portion of the temporal bone, as far as the middle ear, the two cavities being separated by the membrana tympani,[1] a fine membrane with which certain small bones in the tympanum are connected.

This canal is formed by the vaginal process in front and the rest by the petrous portion, but the orifice lies between the mastoid process and the glenoid cavity, and in the fœtus is composed of a separate ring of bone. The canal is longer on its floor and anterior wall than on its roof and posterior part, owing to the obliquity of the membrana tympani.

THE MIDDLE EAR, OR TYMPANUM.

The middle ear, or tympanum, is a cavity within the substance of the petrous portion of the temporal bone, across which the chain of bones passes to connect the membrana tympani with the labyrinth. This cavity is six-sided, possessing a roof, floor, an external and internal wall, and an anterior and posterior extremity. It extends in the same direction as the petrous portion of the temporal bone, inwards and forwards, being nearly half-an-inch in length, and about one-quarter in breadth. By the obliquity of the membrana tympani, already described, the floor and anterior extremity are decreased in size for the enlargement of the corresponding parts of the external auditory canal. The *roof* is formed by the anterior surface of the petrous portion of the temporal bone, and corresponds to that part immediately in front of the elevation of the superior semicircular canal.

The *floor* presents nothing of note, but lies over the position of the jugular fossa.

The *external wall* is occupied chiefly by the oval space across which the membrana tympani[1] is stretched, and behind this appears a small orifice through which the chorda tympani nerve, a branch of the facial, enters the tympanum. In front of the membrana is a small orifice, extending into a canal, through which the chorda tympani leaves the tympanum, and running parallel to this is the Glasserian fissure,[2] which gives passage to the laxator tympani muscle and the tympanic vessels, and contains attached within it the processus gracilis of the malleus.

The *internal wall* faces the membrana tympani, and presents, first, along its upper margin an elongated ridge, due to the course of a canal, the aqueductus Fallopii,[1] through which the portio dura of the seventh nerve runs; and below this a hole, the foramen ovale[2] or fenestra ovalis of oval form, transversely placed and occupied by the base of the stapes which is attached to the margin by a ligament. If the stapes be removed the foramen ovale opens into the vestibule. Still lower and more anterior there is a prominence of considerable size, termed the promontory,[3] which is hollow, corresponding to the cavity of the cochlea, and is marked on its surface by small grooves, in which lie twigs of the tympanic plexus of nerves. Behind the promontory, at its lowest part, a foramen, the fenestra rotunda,[4] leads into the cavity of the cochlea, but when recent it is closed by a membrane.

The *posterior extremity* is marked by several irregular foramina leading into open spaces, the mastoid cells, among which the short crus of the incus is attached by a ligament; and below these, near the internal wall, is a conical process, the pyramid, which is hollow within, and gives origin by its cavity to the stapedius muscle.

The *anterior extremity* gradually contracts, and from it pass forward two parallel canals, situated one above the other, and separated by a thin lamina of bone, the processus cochleariformis. Of the two canals, the superior transmits the tensor tympani muscle inwards to the tympanum, as well as a branch of nerve derived from the otic ganglion, and the inferior is continued onwards by a cartilaginous prolongation to form the Eustachian tube, and, opening into the pharynx, gives passage to air from that cavity into the tympanum, and thence into the mastoid cells.

THE SMALL BONES OF THE EAR (OSSICULA).

Within the cavity of the tympanum are contained three small bones, which by their attachments connect the membrana tympani with the internal ear. The bones receive their names from things to which they bear resemblance—malleus, incus, and stapes.

The *malleus* (hammer) presents a large oval extremity, the head,[1] and below this, a constricted portion, the neck,[2] from which two processes extend, one from its size and direction is termed the handle or manubrium,[3] and from its base projects a small conical elevation, the processus brevis,[5] the other from its length and fineness is called the processus gracilis.[4]

The head,[1] situated near the roof of the tympanum, to which it is attached by the suspensory ligament of the malleus, articulates by its posterior surface with the body of the incus, the joint having a capsular ligament and synovial membrane.

The neck,[2] or constricted part of the bone, receives the insertion of the laxator tympani muscle. The manubrium,[3] the thickest of the processes, is somewhat curved, and is attached in the substance of the membrana tympani in its central line from above downwards. The processus brevis[5] projects upwards and outwards from the manubrium, and receives the insertion of the tensor tympani muscle.

The processus gracilis,[4] a long and thin process, extends forwards and downwards into the Glasserian fissure, and is there attached.

The *incus* (anvil) consists of a body[1] and two crura, one longer than the other. The body is flattened and quadrilateral, with a concave smooth articular facet for articulation with the head of the malleus. Of the crura, the shorter[2] projects backwards to the mastoid cells, where it is attached by a ligament; the longer[3] extends downwards parallel with but on a plane internal to the manubrium of the malleus, and articulates with the head of the stapes, a small cubic piece of bone or cartilage termed the os orbiculare,[4] intervening. As age advances this structure ossifies to the incus and sometimes to the stapes also.

The *stapes* (stirrup) is described as possessing a head, neck, two crura, and a base. The head[1] and neck, however, consist only of a small tubercle of bone, which articulates with the os orbiculare, and receives the insertion of the stapedius muscle. The base[2] is a flattened oval lamina of bone, fitting into the fenestra ovalis on the inner wall of the cavity of the tympanum, and the two crura unite the base with the neck, the anterior crus[4] being straighter, and therefore shorter, than the posterior.[3] The position of the stapes is horizontal with the base inwards, the head outwards and at right angles to its articulation with the long crus of the incus.

THE INTERNAL EAR, OR LABYRINTH.

The internal ear, or labyrinth, is composed of three separate portions, the vestibule[1] most central, behind this the semicircular canals,[2] and in front the cochlea[3].

The *vestibule*[1] is an irregular space within the substance of the petrous portion of the temporal bone, situated with the cavity of the tympanum on its outer side, the meatus auditorius internus on its inner, the cochlea in front, and the semicircular canals behind. It is seemingly composed of two fossæ, of these the fossa hemi-elliptica, which is in the upper and posterior part, is of elongated form, whilst the fossa hemispherica, which is smaller, is in the lower and anterior part, and is of somewhat spheroidal form, the two being separated by a horizontal ridge of bone extending from the inner wall of the vestibule, and termed the crista vestibuli. On the internal wall minute orifices (macula cribrosa) lead into the fossa hemispherica for the transmission of filaments of the auditory nerve, and behind the crest is a small orifice, the aqueductus vestibuli, for the passage of a vein. On the outer wall the vestibule communicates with the tympanum by means of the fenestra ovalis, but this foramen, when recent, is occupied by the base of the stapes and covered by the lining membrane of the cavities. In the posterior wall five orifices communicate with the semicircular canals, and are not closed in the recent state, and again in the anterior and lower part of the vestibule an orifice of some size enters into the scala vestibuli of the cochlea, likewise always open.

The *semicircular canals*[2] are three in number, placed two in a vertical position, one above and anterior to the other, producing the eminence upon the anterior surface of the petrous portion of the temporal bone, and one in a horizontal position external to the others. All open into the posterior and upper part of the vestibule by both their extremities, but the two vertical canals are united together by one extremity, so that instead of six there are but five orifices opening into the vestibule. Each canal is rather more than a semicircle, and at one extremity forms a dilatation, the ampulla. This dilatation occurs in the vertical canals at the extremities which are not united, and in the horizontal canal at that extremity which is the more anterior.

The *cochlea*[3] is of pyramidal form, with the base exactly corresponding to the meatus auditorius internus, and the apex extending forwards and outwards. It consists of a tube taking two turns and a half around a central axis termed the modiolus, and much resembles the shell of a snail lying upon its side. A thin lamina of bone, the lamina spiralis, coils in a similar manner round the modiolus, and taking attachment to it thus partially divides the tube into two parts, each of which is called a scala. The lamina does not extend entirely across the canal from the modiolus to the outer wall, but in the recent state a membrane is attached to the margin, and so completes the separation of the two scalæ. The lamina is also deficient in the apex of the cochlea, allowing the two canals to become continuous with each other; and to the point of junction is given the name of the cupola.

The two scalæ produced by the lamina spiralis communicate with each other at their extremities in the apex of the cochlea, but at their extremities in the base they open, the smaller into the cavity of the vestibule, hence termed the scala vestibuli; the other through the foramen rotundum into the cavity of the tympanum, and termed the scala tympani; but the foramen rotundum in the recent state is closed by a membrane stretched from its margin. In the scala tympani, near to the foramen rotundum, is found a small orifice, the aqueductus cochleæ. The *modiolus* is the axis around which the scalæ turn. It is composed of cancellated bony tissue, along which vessels and nerves pass to the substance of the lamina spiralis, and it generally possesses a central canal, in which is contained the trunk of the vessels and nerves of the cochlea. It is largest in size at the base, generally decreasing, but near the apex again somewhat increases, and this enlargement, from its appearance, is termed the infundibulum.

The *aqueductus Fallopii,* or canal containing the portio dura of the seventh nerve, traverses the substance of the petrous portion of the temporal bone, commencing from the internal auditory meatus,[4] being there the uppermost and largest of the orifices, and terminating at the stylo-mastoid foramen. In its course it is soon joined by the hiatus Fallopii, a canal containing the large superficial petrosal or Vidian nerve, and then turns suddenly backwards along the upper part of the inner wall of the cavity of the tympanum above the foramen ovale, around and behind which it now as suddenly descends to its termination, the stylo-mastoid foramen.

OSSIFICATION.

THE VERTEBRÆ. (8 *points.*)

At six weeks' fœtal life a point appears in each arch and spreads into the lamina and spine, transverse process, articular processes and pedicles, joins and develops a part of the body. At eight weeks a point appears in the body of the bone. At birth the bone consists of three parts, formed from these three centres. At about sixteen years of age an epiphysal point appears at the extremity of the spine, and also of each transverse process; and at about twenty years of age, a point commences to develop a bony plate on the upper and another on the under surface of the body. The bone is complete about the thirtieth year.

The atlas and axis, since they differ from the ordinary form of vertebra, differ also in their development, the former having three points and only one epiphysis, which occurs in the spine, and the latter two extra points for the odontoid process.

The lumbar vertebræ have two extra points for the tubercles which project from the superior articular processes.

THE RIBS. (3 *points.*)

The ribs are developed chiefly from one point for the shaft, which commences about the sixth week, the head and tubercle remaining cartilaginous till some time after puberty, when they become ossified as epiphyses. It must be remembered that the eleventh and twelfth ribs possess no tubercle.

THE STERNUM. (6 *to* 12 *points.*)

Each piece of the sternum is developed from a separate ossific point, not commencing before the fifth month of fœtal life. Occasionally there are two or even four points for the first piece, which does not become united to the rest of the bone until old age, and frequently not at all. The third, fourth, and fifth piece often have two points side by side. The lower four pieces are joined together and often include the ensiform cartilage, as one bone, about forty years of age.

THE BONES OF THE UPPER EXTREMITY.

THE CLAVICLE. (2 *points.*)

The clavicle is the first of all the bones to ossify, and is developed from one point near the centre of the shaft. The sternal extremity ossifies as an epiphysis about the eighteenth year, and unites with the shaft at about twenty-five years of age.

THE SCAPULA. (7 *points.*)

The chief part of the scapula is developed from one point, commencing about the eighth week of fœtal life, and spreading out into the ala, spine, and head. A point for the coracoid process commences shortly after birth. Other points, namely, two for the acromion process, a second point for the coracoid process, one for the inferior angle, and one for the internal border, become developed about the age of puberty, the fifteenth to the seventeenth year, and the entire bone is completely ossified at twenty-five years.

THE HUMERUS. (8 *points.*)

The shaft is developed from a single point, commencing about six weeks fœtal life, and at birth it is nearly ossified. The upper extremity is formed from three points, one in the second year for the head, one in the third year for the great tuberosity, and one the fourth year for the lesser tuberosity, and it joins the shaft at about the twentieth year. The lower extremity is developed from four points, one in the second year for the capitellum, one about the fifth year for the internal condyle, one in the twelfth year for the trochlear surface, and one at puberty for the external condyle. This extremity joins the shaft at about the eighteenth year.

THE RADIUS. 3 *points.*

The radius ossifies from three points, one for the shaft between the fifth and sixth week, one for the lower extremity in the second year, and one for the upper extremity about the seventh year; the upper becomes united to the shaft about the age of puberty, and the lower not until beyond the twentieth year.

THE ULNA. (3 *points.*)

The ulna, like the radius, is developed from three points, one for the shaft between fifth and sixth week, one for the lower extremity in the fourth year, and one for the olecranon process at the tenth or eleventh year. The extremities likewise become united to the shaft at about the same period as those of the radius.

THE CARPUS. (8 *points.*)

Ossific matter is not deposited in any of the carpal bones until after birth. The largest of the series, the os magnum, is the first to commence with a point during the first year and the smallest, the pisiform is the last, the ossific matter in the latter bone being formed about the twelfth year.

Os magnum and unciform in the first year, cuneiform in the third year, trapezium and semilunar in the fifth year, scaphoid sixth year, trapezoid eighth year, and pisiform twelfth year.

THE METACARPUS. (2 *points.*)

The metacarpal bones are developed from two points, one in the centre of the shaft about the sixth week fœtal life, and the second in the head or phalangeal extremity about the third year; union not taking place until the period at which the extremities of other long bones unite, about the twentieth year. The metacarpal bone of the thumb however, bears resemblance to the phalanges, having the second ossific point not in the head but in the base or carpal extremity of the bone.

THE PHALANGES. (2 *points.*)

The phalanges likewise ossify from two points, one for the shaft and small extremity, and the second for the base, in the same manner as the metacarpal bone of the thumb. The points appear, and ossification is complete about the same time as in the metacarpal bones.

THE PELVIC BONES.

THE SACRUM. (33 *points excluding the auricular plates.*)

The sacrum being an extension of the spinal column bears close resemblance to the vertebræ in its ossification.

The five sacral vertebræ possess each the original three points one for the body and one for each lamina (15).

Towards puberty the ossific points (10) develop in the plate on the upper and under surfaces of the body, and by this ossification the fourth and fifth sacral vertebræ are joined together about the eighteenth year, but the others not till the twenty-fifth to the thirtieth year. The lateral parts of the sacrum have an extra point developed near the time of birth for each of the four upper vertebræ (8), and these are joined into a mass about the eighteenth year.

About the eighteenth year the auricular surface becomes developed as an epiphysal plate, and as pointed out in Quain's Anatomy, this plate being formed by several minute points represents the epiphysal points of the vertebral transverse processes which appear from the sixteenth to the eighteenth year. Ossification is complete about the thirtieth year.

THE COCCYX. (*Points variable.*)

The coccyx is developed by one point for each segment. The upper segments sometimes have two ossific points. The points are developed in the first about the time of birth, and in the others at about equal intervals up to the twentieth year.

THE INNOMINATE. (8 *points.*)

The innominate bone is composed of three separate pieces, and, therefore, has three main points of ossification. One for the ilium situated near the acetabulum and commencing about the seventh week of fœtal life, a second commencing in the body of the ischium about the fourth month and the third in the horizontal ramus of the pubes towards the fifth month. Towards the tenth year the ischium and pubes have joined together, and, about the age of puberty, a centre of ossification occurs in the acetabulum, spreading in the Y-shaped cartilage, which still separates the three bones, and thus completes their union. At the same period, that is, the age of puberty, points occur in the crest of the ilium, the anterior inferior spine of the ilium, the tuberosity of the ischium and the symphysis pubis, all of which are developed as epiphyses.

The bone is not completely ossified till between the twenty-fifth and the thirtieth year.

THE BONES OF THE LOWER EXTREMITY.

THE FEMUR. (5 *points.*)

The shaft of the femur is developed from one point which commences about the fifth week of fœtal life. This point spreads afterwards into the neck.

Immediately before or at the time of birth a point appears in the lower extremity, the whole of which is formed from this point as an epiphysis, and unites with the shaft about the twenty-first year.

Near a year after birth a point appears in the head: between the third and fourth year, one in the great trochanter and at puberty, one in the lesser trochanter; these join the shaft somewhere about the eighteenth year.

THE PATELLA. (1 *point.*)

The patella ossifies from one point.

THE TIBIA. (3 *points.*)

The tibia is developed from three points, one for the shaft at the fifth week fœtal life, and one for each extremity. The upper extremity commences to ossify at birth, and unites with the shaft at about the twenty-fifth year. The lower commences to ossify in the second year and joins the shaft between the eighteenth and twentieth year.

THE FIBULA. (3 *points.*)

A point is developed in the shaft between the sixth and seventh week of fœtal life. A second point occurs in the lower extremity during the second year, and joins the shaft about the twentieth year. The third point occurs in the head of the bone near the fourth year, and joins the shaft at the twenty-fifth year.

THE TARSUS. (8 *points.*)

The bones of the tarsus are developed each from one point, but the os calcis has also an epiphysal bony lamina upon its posterior extremity, generally united to the bone about puberty. The order in which they are said to ossify, Os Calcis sixth month, Astragalus seventh month, Cuboid at ninth, External Cuneiform in the first year, Internal Cuneiform in the third year, Middle Cuneiform and Scaphoid in the fourth year, epiphysis of os calcis about tenth year.

THE METATARSUS. (2 *points.*)

The metatarsal bones are formed chiefly from one ossific centre, which commences between sixth and seventh week, and includes the shaft and tarsal extremity. A second point occurs from the third to the sixth year in the head or phalangeal extremity of the bone, which is developed as an epiphysis and unites with the shaft about the twentieth year. The metatarsal bone of the great toe differs from the rest, in that the base, instead of the head, is developed as the epiphysis, in which respect it resembles the phalangeal bones.

THE PHALANGES. (2 *points.*)

The phalanges are developed from two points, one for the shaft and small extremity between seventh and eighth week, and a second from third to sixth year for the base, which is formed as an epiphysis in the same manner as the metatarsal bone of the great toe is developed. The epiphyses unite about the eighteenth year.

THE BONES OF THE HEAD.

THE OCCIPITAL BONE. (7 *points.*)

For some time after birth the occipital bone is composed of four pieces, the whole of the vertical portion in one piece, the basilar piece, and two lateral pieces. The vertical portion is developed from four points commencing about the sixth week, one in each of the four fossæ into which the cerebral surface is divided, the four points meeting in ossification at the internal protuberance or position of the torcular Herophyli. The lateral pieces are developed each from one point, commencing in the condyle, and the basilar piece also from one; in all seven centres of ossification. The bone is completely united about the seventh year, and about the twentieth year it becomes joined to the sphenoid.

THE PARIETAL BONE. (1 *point.*)

The parietal bone is developed from one point only, situated at the parietal eminence and commencing about the sixth week. Ossification does not extend to the two upper angles for some months after birth, accounting for the anterior and posterior fontanelles.

THE TEMPORAL BONE. (6 *points.*)

The temporal bone has ossific centres commencing about the seventh week for each of its three divisions, squamous, petrous, and mastoid; also one for the zygomatic process, one for the tympanic bone, and one for the styloid process, which last occasionally does not unite to the bone, but articulates with a movable joint: in all six points. Frequently, however, the zygomatic and squamous portions are developed from the same point, making only five points.

At birth there are three pieces, the squamous with the zygoma attached, the petrous and mastoid in one piece, and the tympanic bone.

The tympanic bone is simply a ring for the support of the membrana tympani, but it afterwards becomes considerably enlarged, extends outwards as the auditory process, and so forms the meatus auditorius externus, and deepens the cavity of the glenoid fossa.

THE FRONTAL BONE. (2 *points.*)

The frontal bone ossifies from two points commencing about the sixth week, one at each of the frontal eminences. The two pieces thus formed are separated from each other by the frontal suture for a variable period after birth.

THE SPHENOID BONE. (10 *points.*)

Ossification commences about the seventh week. The body of the sphenoid bone is developed from two points.

Each of the lesser and each of the greater wings has a separate point; that for the lesser being situated at the junction of its two roots external to the optic foramen; that for the greater spreading also into the external plate of the pterygoid process. The internal pterygoid plate has a separate point of ossification, and so also has each of the sphenoidal turbinated bones. At birth there are three separate pieces. The great wings with both plates of the pterygoid process form two, and the third is composed of the rest of the bone. The sphenoidal turbinated bones commence to ossify about the third year, and join the sphenoid at puberty.

THE ETHMOID BONE. (3 *points.*)

The ethmoid bone is developed from three points, one for each lateral cellular mass, appearing about the fifth month fœtal life, and one which includes the perpendicular and cribriform plates and crista galli, commencing about a year after birth.

The lateral masses increase in size very considerably after birth, by the enlargement of their contained cells.

BONES OF THE FACE.

THE SUPERIOR MAXILLARY BONE. (5 *main points.*)

The superior maxillary bone commences to ossify about the fifth week, and proceeds rapidly. It has a separate point for the palatine process, the malar portion, the facial portion, the nasal process, the incisor portion (that is, the part including the incisor teeth), and a variable number for the alveoli. Occasionally the incisor portion does not unite with the rest of the bone, but leaves an open fissure upon one or both sides (Hare lip).

THE PALATE BONE. (1 *point.*)

The palate bone, though of a remarkably irregular form, ossifies from one point only, which appears about the seventh week, situated at the root of the tuberosity, the junction of its several parts. At birth the perpendicular plate is remarkably short.

THE MALAR BONE. (1 *point.*)

The malar bone is developed from one point, about the seventh week.

THE LACHRYMAL BONE. (1 *point.*)

The lachrymal bone has one centre of ossification about the seventh week.

THE NASAL BONE. (1 *point.*)

The nasal bone has one centre about the seventh week.

THE INFERIOR TURBINATED BONE. (1 *point.*)

The inferior turbinated, or spongy, bone has one point, which appears about fifth month fœtal life.

THE VOMER. (1 *point.*)

The vomer is developed from one point, about seventh week.

THE INFERIOR MAXILLARY BONE. (*Points doubtful.*)

The lower jaw is one of the first bones to ossify. It is developed chiefly from two points, one for each side, the two uniting at the symphysis in the second year. There is said to be a separate point for the condyle and for the coronoid process, and also one for the internal lamina of the bone.

After the completion of ossification, bone substance consists of about one-third of animal matter (gelatine), and the remaining two-thirds earthy matter, chiefly phosphate of lime, with some carbonate of lime and a little phosphate of magnesia. To the animal matter is due the elasticity and flexibility of the bone, and to the earthy matter the solidity.

The development of the bones takes place according to the time and manner of its requirements; for it is seen from the foregoing, that the shafts of long bones are very considerably advanced in ossification at the time of birth; and again, that certain bones, such, for instance, as those of the head, rapidly ossify after birth, and, on the contrary, that most of the epiphyses of long bones do not become united to the shaft until from twenty to twenty-five years of age, when the stature has ceased to increase.

Then, with regard to the substance of bones, the ossific matter is deposited either in extreme closeness, as occurs in what is termed compact osseous tissue, of which tissue the greater portion of the shaft of a bone is composed, whilst the heads or large extremities are covered only with a thin layer; or, in large open reticulations, as occurs in what is termed the cancellated osseous tissue, of which is composed the chief part of heads or large extremities of bones, but only a small central portion of the shaft; the former variety being evidently for strength, the latter for volume without weight.

In consequence of the different forms which bones present, they have been divided into separate classes:—

1. Long bones, such as those of the limbs, the metacarpus, metatarsus, and phalanges.

2. Short bones, such as the vertebræ, carpus.

3. Flat bones, such as those enclosing cavities; a good example being the bones of the head.

A fourth is described, including bones which scarcely bears resemblance to either of the foregoing classes; examples being the lower jaw, the sternum, and the ribs.

The flat bones of the head differ from other bones, in having two laminæ of compact tissue, termed the external and the internal table, separated from each other by layers of cancellated tissue, termed the diploe, in which are found large veins and nutrient vessels.

The temporal bone is peculiar in possessing a squamous portion resembling the flat bones of the skull; a mastoid portion, composed of large cells and cancellated structure, and a petrous portion, composed chiefly of the solid compact tissue, protecting the organ of hearing.

INDEX.

Page
Astragalus 55
Atlas 4
Axis 5
Base of Skull 98
,, Cerebral view 101
,, Inferior view 98
Calcaneum 54
Carpus 24
Cartilages, Costal 10
Cervical Vertebræ 4
Clavicle.... 13
Coccyx 36
Cochlea (Ear) 113
Cuboid Bone 59
Cuneiform Bone (Carpus) 26
,, External (Tarsus) 58
,, Internal ,, ... 56
,, Middle ,, ... 57
Dorsal Vertebræ 6
Ear 111
Ethmoid Bone 79
External Cuneiform Bone (Tarsus) 58
Extremity, Lower 44
,, Upper 13
Face, Bones of the 83
Femur 44
Fibula 51
Foot 54
Fossa, Nasal 106
,, Orbital 105
,, Pterygo-Maxillary 105
,, Spheno-Maxillary 104
,, Temporal 104
,, Zygomatic 105
Frontal Bone 73
Hand 24
Humerus 17
Ilium 37
Incus (Ear) 112
Inferior Maxilla 95
Inferior Turbinated Bone 93
Innominate Bone 37
Internal Cuneiform Bone 57
Internal Ear 113

Page
Ischium 37
Lachrymal Bone 92
Lower Extremity, Bones of 44
Lumbar Vertebræ 7
Magnum Os 29
Malar Bone 87
Malleus.... 112
Maxilla Inferior 95
,, Superior 83
Metacarpus 31
Metatarsus 60
Middle Cuneiform Bone 58
Nasal Bone 92
Nasal Fossa 106
Occipital Bone 64
Orbital Fossa 105
Os Calcis 53
Os Magnum 29
Ossification 115
Palate Bone 89
Parietal Bone 66
Patella 47
Pelvis, Bones of 34
,, Description of 41
Phalanges of Foot 62
Phalanges of Hand 33
Pisiform Bone 27
Pterygo-Maxillary Fossa 105
Pubes 37
Radius 20
Ribs 8
Rib, First 9
Sacrum.... 34
Scaphoid Bone (Carpus) 25
,, (Tarsus) 56
Scapula.... 15
Semicircular Canals 114
Semilunar Bone 26
Sesamoid Bones 62
Skull, As a whole 97
,, Bones of.... 64
,, Fossæ 101
,, Inferior view of.... 98
Spinal Column 2

	Page
Sphenoid Bone....	75
Sphenoidal Turbinated Bone	75
Stapes	112
Sternum	11
Superior Maxilla	83
Tarsus, Bones of	53
Temporal Bone....	68
„ Fossa	104
Thorax, Bones of	8
„ Description of....	12
Tibia	48
Trapezium	28
Trapezoid Bone....	28
Turbinated Bone, Inferior	93
Tympanic Cavity (Ear)	109
Ulna	22
Unciform Bone	30
Upper Extremity	13
Vertebræ	2
„ Cervical	4
„ Dorsal	6
„ Lumbar	7
Vestibule (Ear)	112
Vomer	94
Wormian Bones	97
Zygomatic Fossa	104

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OSTEOLOGY:

A CONCISE

DESCRIPTION OF THE HUMAN SKELETON,

ADAPTED FOR

THE USE OF STUDENTS IN MEDICINE,

BY

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Atlas of Plates.

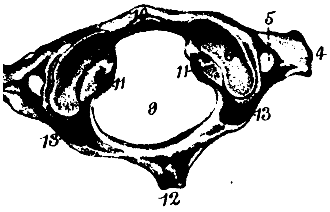
SECOND EDITION.

LONDON:
BAILLIERE, TINDALL, AND COX,
20, KING WILLIAM STREET, STRAND, W.C.
1874.

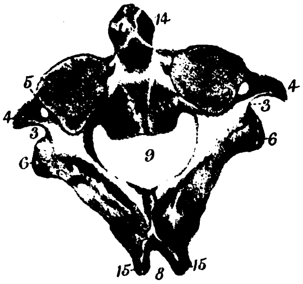
Plate I.

THE VERTEBRÆ.

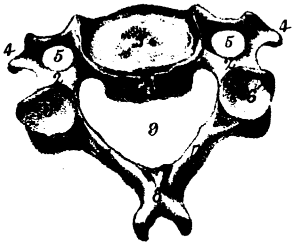
ATLAS.



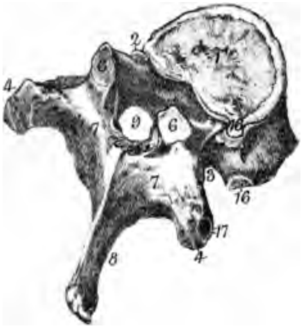
AXIS.



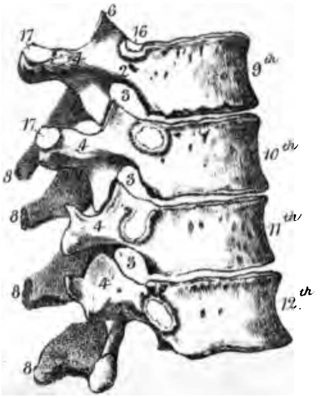
CERVICAL



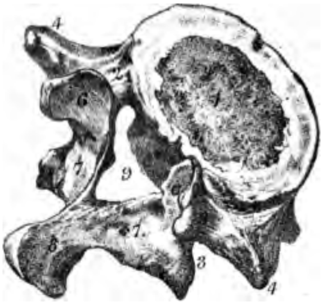
DORSAL



LOWER DORSAL



5TH LUMBAR



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Where a figure is repeated, a line drawn from one to the other denotes the extent of the part described. **O.**, *origin.* **I.**, *insertion.*

PLATE I.

THE VERTEBRÆ.

1. Body.

2. Pedicles.

3. Vertebral notches through which the spinal nerves leave the canal.

4. Transverse processes: those of the atlas give origin to superior oblique, and insertion to inferior oblique muscles.

5. Foramen for the vertebral artery.

6. Articular process.

7. Laminæ.

8. Spine.

9. Spinal foramen.

10. Anterior arch of atlas.

11. Rough depressions for the attachment of the transverse ligament of the atlas.

12. Rudimentary spine of the atlas, and origin of the two recti capitis postici minores.

13. Groove traversed by the vertebral artery and first cervical nerve.

14. Odontoid process.

15. **O.** Inferior oblique, and rectus capitis posticus major.

16. Half facets upon the body of the dorsal vertebræ for articulation with the heads of the ribs.

17. Facets upon the transverse processes of the dorsal vertebræ for articulation with the tubercles of the ribs.

PLATE II.

THE THORAX.

The thorax, a conical space bounded in the median line anteriorly by the sternum, in the median line posteriorly by the bodies of the dorsal vertebræ, laterally by the ribs and their cartilages.

The upper or cervical aperture is bounded by the first dorsal vertebra, the first rib and its cartilage, and the upper border of the manubrium.

The lower or abdominal aperture, much the larger, is bounded by the xyphoid cartilage, the 7th, 8th, 9th, 10th, and the extremities of the 11th and 12th costal cartilages, the lower margin of the last rib, and the 12th dorsal vertebra.

THE RIBS.

1. Head presenting two facets for articulation with two dorsal vertebræ: the ridge separating the facets attaches an interarticular ligament.
2. Neck of the rib: it attaches the anterior costo-transverse ligament by its superior margin, and by its posterior surface the middle costo transverse ligament.
3. Tubercle of the rib, articulates by a facet with the transverse process of the lower of the two vertebræ with which it is connected, and by a rough marking gives attachment to the posterior costo-transverse ligament.
4, Angle of the rib, between which and the tubercle parts of the erector spinæ take both origin and insertion.
5. Groove of the rib, the two margins of which attach the external and the internal intercostal muscles.
6. Superior border attaches both external and internal intercostals.
7. Concavity for the reception of the costal extremity of the costal cartilage.

FIRST RIB.

1. Head with one facet only.
2. Neck, does not attach an anterior costo transverse ligament.
3. Tubercle.
4. **O.** Scalenus medius, from a rough line or groove upon the posterior third of the upper surface.
5. Tubercle, and rough line extending from it forwards and outwards, for the origin of the scalenus anticus muscle.
6. Groove running forwards and outwards behind the scalenus anticus muscle for the subclavian artery.
7. **O.** Subclavius muscle from the upper surface of the rib at its junction with the costal cartilage.
8. Articulation with first costal cartilage.

THE PELVIS.

1. Sacrum.
2. Ala of ilium, and **O.** internal iliac muscle.
3. Body of fifth lumbar vertebra.

The brim of the true pelvis, or separation from the false pelvis is formed by:

4. Horizontal ramus of pubes,
5. Ilio pectineal eminence,
6. Ilio pectineal line,
7. Sacro-iliac synchondrosis.

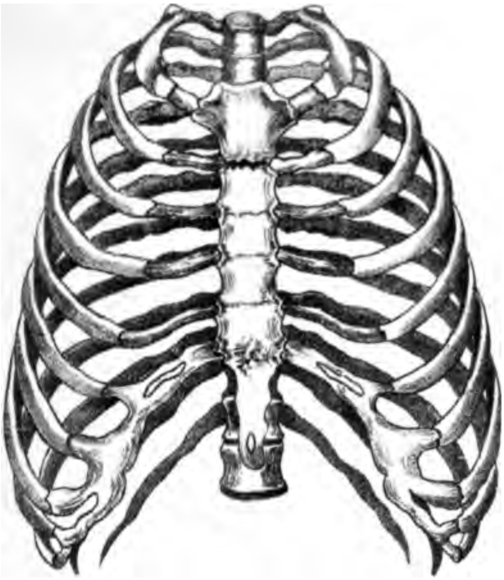
The superior aperture of the true pelvis in the male is larger from before backwards than from side to side, but the reverse in the female, and its plane is such that its axis would be in a line drawn from the umbilicus to the tip of the coccyx.

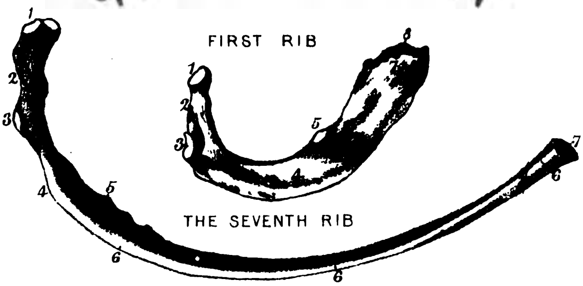
The inferior aperture of the true pelvis is very irregular, owing to the greater and lesser sciatic notches, and to the downward projection of the coccyx, but it is rendered more even in outline, and smaller in size, by the greater and lesser sacro-sciatic ligaments which extend from the sides of the sacrum and coccyx to the tuberosity and to the spine of the ischium. Its plane is such that its axis lies in a line drawn from the promontory of the sacrum through a point midway between the tuberosities of the ischia.

Differences of the female pelvis. More delicately formed; of larger dimensions, particularly from side to side; alæ of ilia more shallow but extended in width; brim oval and larger from side to side than from before backwards; pubic arch larger, broader, smooth and shelving on its posterior aspect, rounded at the symphysis pubis; obturator foramen triangular; sacrum shorter, broader, more curved; coccyx more movable; cavity not so deep.

8. Spine of pubes.
9. Line for the attachment of Gimbernat's ligament.
10. Crest of pubes.
11. Groove for the tendon of the obturator externus muscle.
12. Acetabulum.

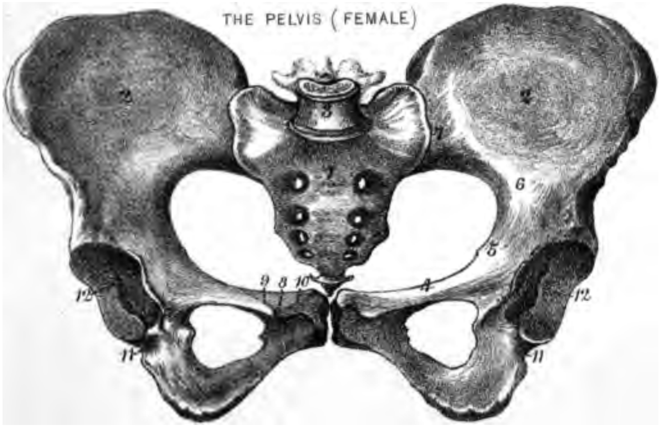
THE THORAX





FIRST RIB

THE SEVENTH RIB

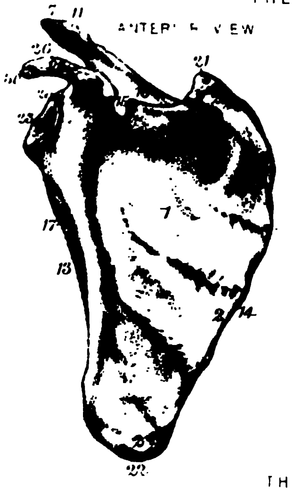


THE PELVIS (FEMALE)

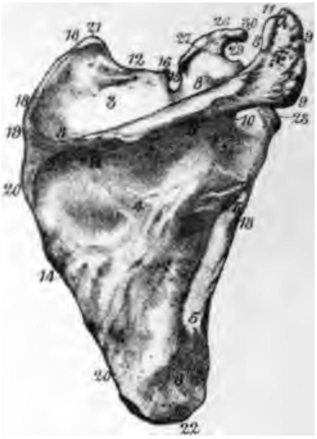
Plate III.

THE SCAPULA

ANTERIOR VIEW

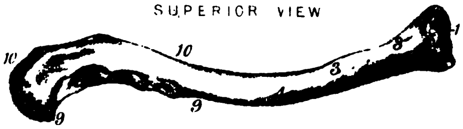


POSTERIOR VIEW

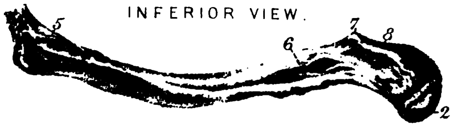


THE CLAVICLE

SUPERIOR VIEW

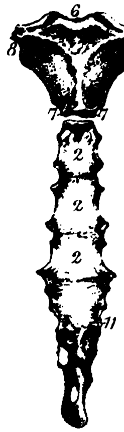


INFERIOR VIEW.



THE STERNUM

ANTERIOR VIEW



POSTERIOR VIEW.

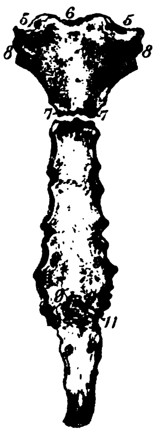


PLATE III.

THE STERNUM.

1. **O.** Sternal portion of sterno-mastoid, by a rounded tendon.
2. **O.** Pectoralis major.
3. **O.** Sterno-hyoid.
4. **O.** Sterno-thyroid.
5. Facet for articulation with the clavicle.
6. Interclavicular notch.
7. Half facet for second costal cartilage.
8. Rough margin for attachment of the first rib.
9. **O.** Triangularis sterni.
10. **O.** Diaphragm.
11. Position at which the ensiform or xyphoid cartilage is attached to the gladiolus.

THE CLAVICLE.

1. Facet for articulation with sternum.
2. Oval facet for articulation with the acromion process of the scapula.
3. **O.** Clavicular portion of sterno-cleido mastoid, nearly two inches in length.
4. **O.** Clavicular portion of pectoralis major, from sternal half of anterior aspect.
5. Rhomboid depression for costo-clavicular ligament.
6. Subclavian groove, in the depths of which the subclavius muscle is inserted, and to the borders the costo-coracoid ligament is attached: in it also is usually the nutrient foramen.
7. Tubercle which attaches conoid portion of coraco-clavicular ligament.
8. Line which attaches trapezoid portion of caraco-clavicular ligament.
9. **O.** Deltoid from the anterior border of the outer third of the clavicle.
10. **I.** Trapezius, posterior border of the outer third of the clavicle.

THE SCAPULA.

1. Anterior surface, or venter and **O.** subscapularis.
2. **I.** Serratus magnus into the anterior aspect of the posterior margin.
3. Supraspinous fossa and **O.** supraspinous muscle.
4. Infraspinous fossa and **O.** infraspinous muscle.
5. **O.** Teres minor from dorsal aspect of the anterior border.
6. **O.** Teres major from dorsal aspect of lower angle.
7. Acromion process gives **O.** to deltoid by lower border, **I.** to trapezius by upper border.
8. Superior margin of spine and **I.** trapezius.
9. Inferior margin of spine and **O.** deltoid.
10. External margin of spine, and boundary of the neck.
11. Facet for articulation with clavicle.
12. Superior border of the scapula.
13. External or axillary border.
14. Internal or vertebral border, or base.
15. Suprascapular notch, transmits the suprascapular nerve.
16. **O.** Omo-hyoid muscle.
17. **O.** Long head of triceps, from fossa one inch and a half in length upon the anterior border.
18. **I.** Levator anguli scapulæ.
19. **I.** Rhomboideus minor.
20. **I.** Rhomboideus major.
21. Superior angle of the scapula.
22. Inferior angle: it often attaches fibres of latissimus dorsi.
23. External angle or head of the scapula.
24. The glenoid fossa, pyriform in shape with the apex upwards.
25. **O.** Long head of biceps from the glenoid ligament at the apex of the glenoid fossa.
26. The coracoid process.
27. Coraco-clavicular ligaments, conoid and trapezoid.
28. **I.** Pectoralis minor into the anterior border of coracoid process.
29. Coraco-acromial ligament, attached by its base to the posterior margin of the coracoid process.
30. **O.** Coraco-brachialis, and short head of biceps from the apex of the coracoid process.

PLATE IV.

THE HUMERUS.

1. Head.
2. Anatomical neck.
3. External tuberosity. I. supraspinous, infraspinous, and teres minor.
4. Internal tuberosity. I. subscapularis.
5. Bicipital groove transmitting long head of biceps and articular artery: its external border I. pectoralis major, and its internal border I. teres major, and latissimus dorsi.
6. Surgical neck.
7. O. Brachialis anticus.
8. Internal condyloid ridge.
9. External condyloid ridge. O. supinator radii longus, and extensor carpi radialis longior.
10. I. Coraco-brachialis.
11. I. Deltoid.
12. O. Mass of triceps.
13. O. External head of triceps as high as I. teres minor.
14. O. Internal head of triceps as high as I. teres major.
15. Musculo spiral groove for same nerve.
16. Internal condyle. O. pronator radii teres; flexor carpi radialis; palmaris longus; flexor sublimis digitorum; flexor carpi ulnaris and internal lateral ligament.
17. External condyle. O. extensor carpi radialis brevior; extensor communis digitorum; extensor minimi digiti; extensor carpi ulnaris and anconeus, and external lateral ligament.
18. Capitellum articulates with radius.
19. Trochlear surface articulates with ulna.
20. Coronoid fossa.
21. Fossa for head of radius.
22. Olecranon fossa.

RADIUS.

1. Head.
2. Neck, plays within the annular ligament.
3. Tuberosity. I. biceps.
4. Internal border for interosseous membrane.
5. Sigmoid cavity of radius, articulates with lower extremity of ulna.
6. Anterior border.
7. Oblique line of the radius. I. supinator radii brevis. O. flexor sublimis digitorum.
8. I. Pronator quadratus into lower fifth of the radius.
9. O. Flexor longus pollicis from $\frac{2}{3}$ only of the depression below the oblique line.
10. I. Supinator brevis.
11. O. Extensor ossis metacarpi pollicis.
12. O. Extensor primi internodii pollicis.
13. I. Pronator radii teres.
14. Articular facet for scaphoid and semi-lunar bones.
15. Styloid process, apex attaches external lateral ligament of wrist.
16. I. Supinator radii longus.
17. Groove for extensor ossis metacarpi pollicis and extensor primi internodii pollicis.
18. Groove for extensor secundi internodii pollicis.
19. Groove for extensor communis digitorum, and extensor indicis.
20. Groove for extensor carpi radialis longior and brevior.

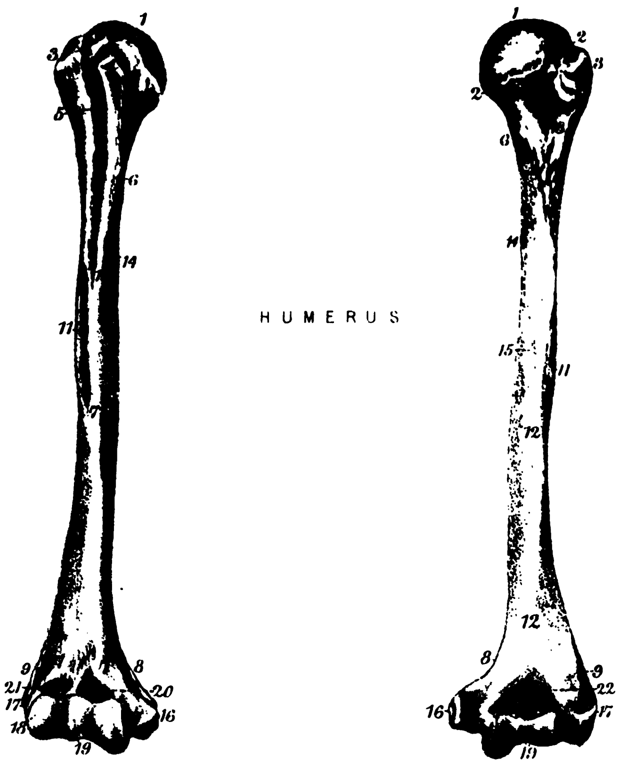
ULNA.

1. Olecranon process.
2. Coronoid process.
3. Great sigmoid cavity.
4. Lesser sigmoid cavity.
5. I. Triceps upon upper surface of olecranon process.
6. I. Brachialis anticus upon coronoid process.
7. Tubercle for oblique ligament.
8. O. Second head of pronator radii teres and flexor sublimis digitorum.
9. Interosseous or external border.
10. O. Flexor profundus digitorum, from anterior and internal surface of ulna.
11. O. Pronator quadratus.
12. Posterior border: it attaches an aponeurosis common to flexor prof. dig.; flexor carpi ulnaris, and extensor carpi ulnaris.
13. O. Supinator brevis, fossa below lesser sigmoid cavity.
14. I. Anconeus, triangle above oblique line.
15. O. Extensor ossis metacarpi pollicis.
16. O. Extensor primi internodii pollicis (rarely present).
17. O. Extensor secundi internodii pollicis.
18. O. Extensor indicis.
19. Articular surface of inferior extremity.
20. Styloid process, apex attaches internal lateral ligament.
21. Groove for the tendon of extensor carpi ulnaris.

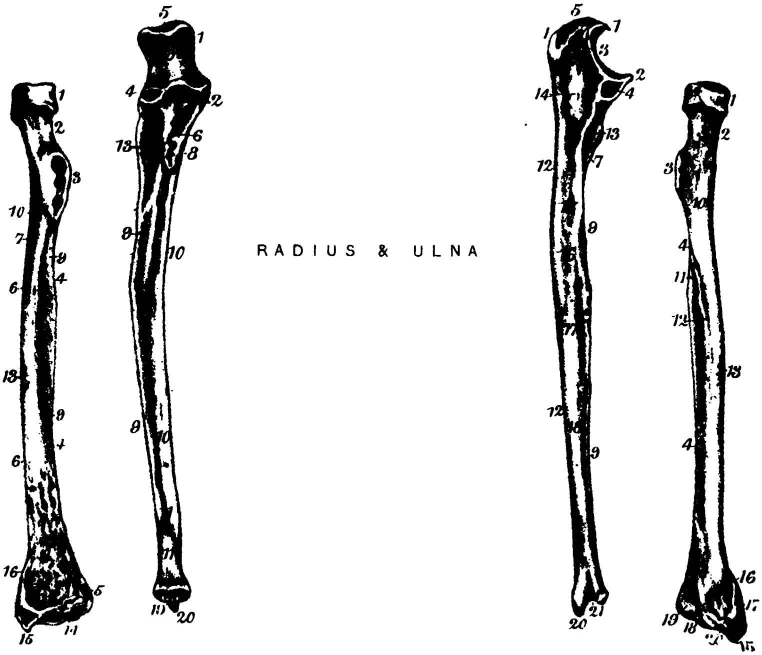
Plate IV.

ANTERIOR VIEW.

POSTERIOR VIEW.



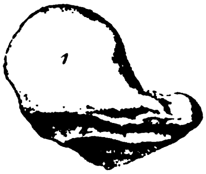
HUMERUS

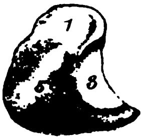


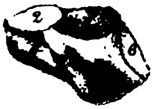
RADIUS & ULNA

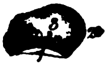
J. S. Coleman del et lith:

THE BONES OF THE CARPUS.

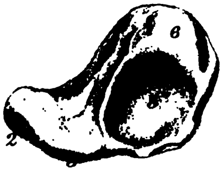


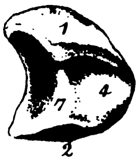


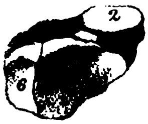


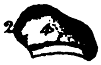


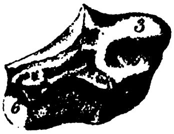
SCAPHOID SEMILUNAR CUNEIFORM PISIFORM

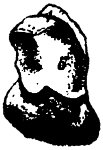


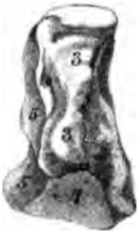


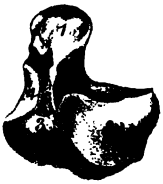




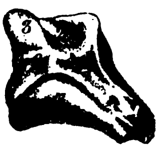


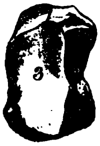


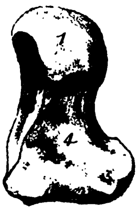




TRAPEZIUM TRAPEZIOD MAGNUM UNCIFORM.







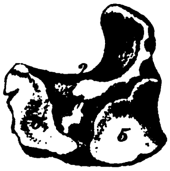


PLATE V.

THE CARPUS.

SCAPHOID.

1. Surface for articulation with radius.
2. Surface for trapezium.
3. Small internal facet for trapezoid.
4. Posterior ligamentous groove.
5. Concavity for the head of the magnum.
6. Facet for the outer semilune of the semilunar bone.
7. Anterior ligamentous surface attaching the anterior annular ligament at the tubercle.

SEMILUNAR.

1. Palmar surface, larger than dorsal.
2. Dorsal surface.
3. External semilune for scaphoid.
4. Internal semilune for cuneiform.
5. Superior surface articulates with radius.
6. Inferior surface concave for the head of the os magnum.
7. Small facet upon the inferior surface for the unciform bone.

CUNEIFORM.

1. Rough ligamentous portion of the anterior surface.
2. Smooth portion of the anterior surface for pisiform bone.
3. Smooth portion of superior surface for fibro-cartilage of wrist-joint.
4. Rough portion of superior surface for internal lateral ligament of wrist.
5. Facet on inferior surface for the unciform bone.
6. Base: articulates with semilunar.

PISIFORM.

1. Oval posterior surface, articulates with cuneiform.
2. The external extremity, protects the ulnar nerve and vessels.
3. Superior surface. **I.** flexor carpi ulnaris.
4. Inferior surface, grooved transversely. **O.** abductor minimi digiti.

TRAPEZIUM.

1. Palmar surface.
2. Groove for flexor carpi radialis.
3. Ridge of groove. **O.** abductor pollicis, opponens pollicis, outer head of flexor brevis pollicis.
4. Facet for trapezoid.
5. Facet for scaphoid.
6. Facet for metacarpal bone of index.
7. Saddle-shaped surface for the metacarpal bone of the thumb.
8. Rough surface attaching external lateral ligament of wrist.

TRAPEZOID.

1. Palmar surface.
2. Dorsal surface.
3. Inferior or saddle-shaped surface for metacarpal bone of index.
4. Superior surface for scaphoid.
5. External surface for trapezium.
6. Internal surface for os magnum with rough centre for interosseous ligament.

OS MAGNUM.

1. Portion of head for semilunar bone.
2. Portion of head for scaphoid.
3. Palmar surface.
4. Dorsal surface.
5. External surface, articulates with trapezoid.
6. Internal surface, articulates with unciform.
7. Inferior or metacarpal surface, articulates with third metacarpal bone and slightly also with the second and fourth.

UNCIFORM.

1. Unciform process, attachment of anterior annular ligament and **O.** flexor brevis minimi digiti and opponens minimi digiti.
2. Palmar surface.
3. Dorsal surface.
4. Surface for fifth metacarpal bone.
5. Surface for fourth metacarpal bone.
6. Facet on external surface for os magnum.
7. Rough surface for interosseous ligament.
8. Facet on internal surface for the cuneiform bone.

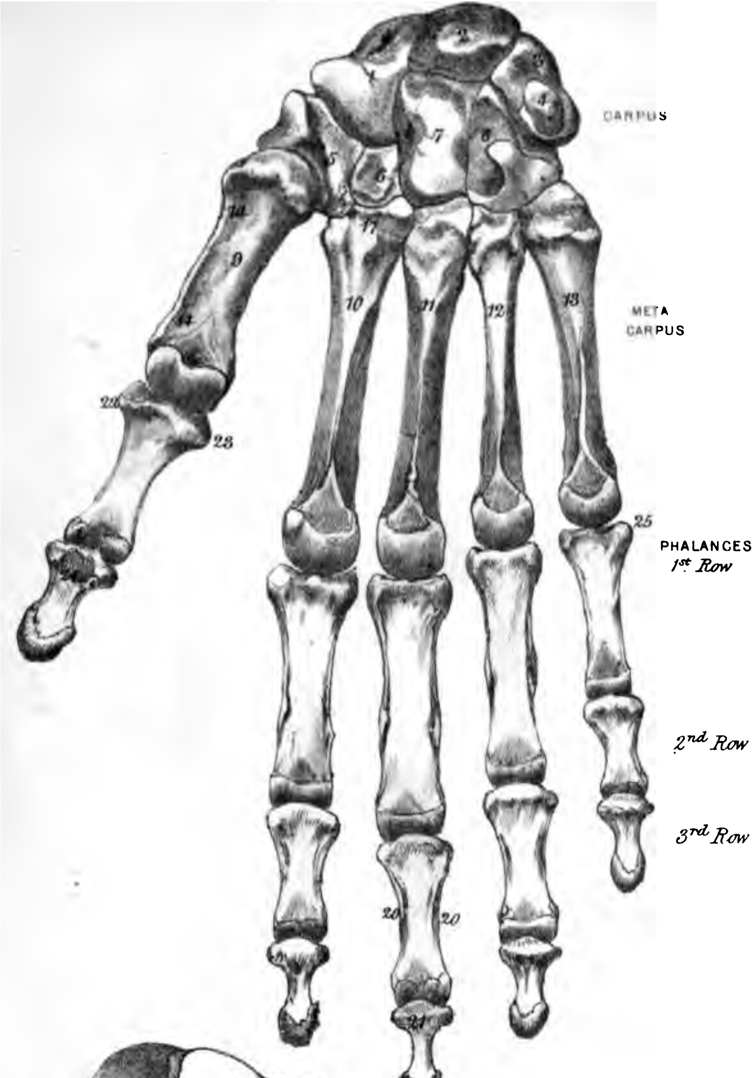
PLATE VI.

THE HAND.

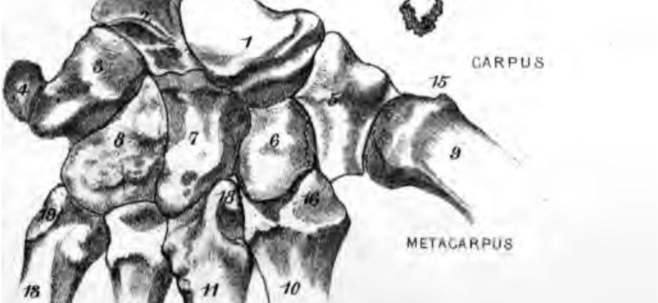
1. Scaphoid.
2. Semilunar.
3. Cuneiform.
4. Pisiform.
5. Trapezium.
6. Trapezoid.
7. Os Magnum.
8. Unciform.
9. Metacarpal bone of thumb.
10. Metacarpal bone of index.
11. Metacarpal bone of middle finger.
12. Metacarpal bone of ring finger.
13. Metacarpal bone of little finger.
14. I. Flexor ossis metacarpi pollicis, or opponens pollicis, into the whole length of the metacarpal bone.
15. I. Extensor ossis metacarpi pollicis, into tubercle upon outer side of the base of the metacarpal bone of the thumb.
16. I. Extensor carpi radialis longior, into posterior aspect of the base of the metacarpal bone of the index finger.
17. I. Flexor carpi radialis, into anterior aspect of the same.
18. I. Extensor carpi radialis brevior, into tubercle upon the posterior aspect of the base of the metacarpal bone of the middle finger.
19. I Extensor carpi ulnaris, into the posterior aspect of the base of the metacarpal bone of the little finger.
20. I. Flexor sublimis digitorum, into both sides of the middle phalanx of the fingers.
21. I. Flexor profundus digitorum, into the anterior aspect of the base of the terminal phalanx of the fingers.
22. I. Abductor pollicis and outer head of flexor brevis pollicis, into outer side of the first phalanx of the thumb.
23. I. Adductor pollicis and inner head of flexor brevis pollicis, into inner side of the same.
24. I. Flexor longus pollicis, into anterior surface of the base of the terminal phalanx of the thumb.
25. I. Abductor minimi digiti and flexor brevis minimi digiti.

Interosseous muscles arise from the adjacent surfaces of the metacarpal bones.

THE HAND



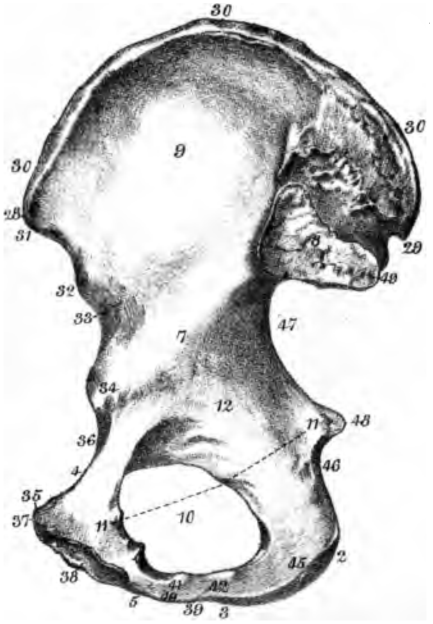
ANTERIOR VIEW.



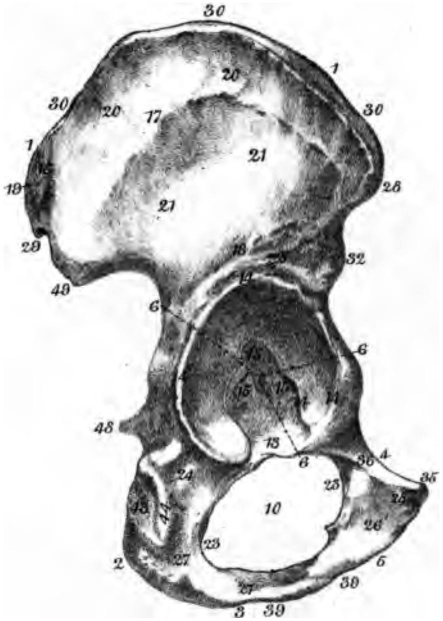
POSTERIOR VIEW.

OS INNOMINATUM.

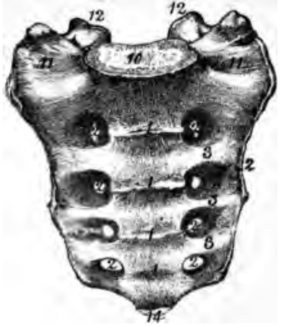
INTERNAL VIEW.



EXTERNAL VIEW.



SACRUM
ANTR



SACRUM
POSTR

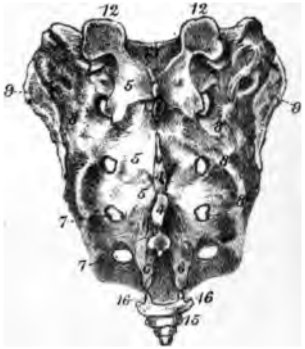


PLATE VII.

THE SACRUM.

1. Transverse lines, original separation of sacral vertebræ.
2. Anterior sacral foramina, for anterior sacral nerves.
3. O. Pyriformis from three central vertebræ.
4. Rudimentary spinous processes.
5. Laminæ and O. erector spinæ.
6. Cornua of the sacrum.
7. Posterior sacral foramina for posterior sacral nerves.
8. Incorporated transverse processes, and O. glutæus maximus, and sacro-sciatic ligaments.
9. Lateral surface, part rough, for sacro-iliac ligament.
10. Body of first sacral vertebra.
11. Ala of sacrum.
12. Superior articular processes.
13. Sacro-spinal canal.
14. Apex of sacrum.
15. Coccyx, margin attaches sciatic ligaments, and O. glutæus maximus. I. coccygeus; apex O. sphincter ani.
16. Cornua of the coccyx.

OS INNOMINATUM.

1. Ala of ilium.
2. Tuberosity of ischium.
3. Ascending ramus of ischium.
4. Horizontal ramus of pubes.
5. Descending ramus of pubes.
6. Junction of the three bones in the acetabulum.
7. Ilio pectineal line.
8. Auricular surface for articulation with sacrum, and part rough for sacro-iliac ligaments.
9. O. Iliacus muscle from whole of iliac fossa.
10. Obturator foramen transmits obturator vessels and nerve.
11. O. Levator ani from fascia stretched from pubes to spine of ischium.
12. O. Obturator internus, from the circumference of the foramen and surface behind it.
13. Vascular aperture to joint.
14. Cotyloid ligament around circumference of acetabulum, and continued across the notch by the transverse ligament.
15. Ligamentum teres.

The capsular ligament is attached outside the cotyloid.

16. Superior curved line.
17. Middle curved line.
18. Inferior curved line.
19. O. Glutæus maximus.
20. O. Glutæus medius, from whole of surface between superior and middle curved lines.
21. Glutæus minimus, from surface between middle and inferior lines.
22. O. External head of rectus femoris, between inferior line and acetabulum.
23. O. Obturator externus, from inner half of obturator foramen.
24. Groove for tendon of obturator externus.

Below this groove, extending into lesser sacro-sciatic foramen, the gemellus inferior arises.

25. O. Adductor longus by a round tendon.
26. O. Adductor brevis.
27. O. Adductor magnus.
28. Anterior superior spine (Poupart's ligament)
29. Posterior superior spine.
30. Crest of ilium, extending between the anterior superior and the posterior superior spines, divided into three lines or lips, of which the external: O. tensor fasciæ femoris, anterior inch. I. obliquus externus anterior ⅔. O. latissimus dorsi posterior ⅓. Middle lip. O. obliquus internus at anterior ⅔. O. erector spinæ posterior ⅓. Internal lip. O. transversalis abdominis, from anterior ¾. O. quadratus lumborum, posterior ¼.
31. O. Sartorius, from one inch of anterior border.
32. Anterior inferior spine. O. internal head of rectus femoris, and ilio femoral ligament.
33. Groove for psoas and iliacus.
34. Ilio pectineal eminence. I. psoas parvus.
35. Spine of pubes (Poupart's ligament), and extending one inch outwards (Gimbernat's ligament).
36. O. Pectineus from ridge, and depression in front.
37. Crest of pubes. I. tendon of external oblique, internal oblique, and transversalis. O. pyramidalis, and rectus abdominis.
38. Surface for articulation with fellow.
39. O. Gracilis, from two inches of the margin.
40. Crus penis, attached to about an inch and a-half of the pubic arch, and O. erector penis along its outer margin and below it.
41. O. Elevator and constrictor urethræ.
42. O. Transversus perinæi.
43. O. Hamstrings from tuberosity of ischium (semimembranosus, long head of biceps, and semitendinosus).
44. O. Quadratus femoris, from outer margin of tuberosity of ischium.
45. Great sacro-sciatic ligament attached to lip on internal margin of tuberosity.
46. Lesser sciatic notch, transmitting internal pudic vessels and nerve into the perinæum, and obturator internus out of the pelvis.
47. Great sciatic notch transmitting out of the pelvis glutæal vessels and nerve, pyriformis muscle, sciatic and pudic vessels and nerves.
48. Spine of ischium, attaches lesser sacro-sciatic ligament, and on its outer surface O. gemellus superior, on its inner O. levator ani and coccygeus.
49. Posterior inferior spine of the ilium.

PLATE VIII.

THE FEMUR.

1. Head.
2. Depression for ligamentum teres.
3. Neck.
4. Trochanter major.
5. Trochanter minor. I. Psoas and iliacus.
6. I. Glutæus minimus on the fore part of the great trochanter.
7. I. Pyriformis, gemellus superior, obturator internus and gemellus inferior upon upper margin of great trochanter.
8. Digital fossa. I. obturator externus.
9. I. Glutæus medius into oblique line on outer surface of great trochanter.
10. O. Vastus externus from base of great trochanter, line leading from great trochanter to linea aspera, outer lip of linea aspera, and a-half the line from linea aspera to outer condyle.
11. O. Vastus internus from internal surface of femur, internal lip of linea aspera, lines leading from linea aspera upwards to small trochanter, downwards to internal condyle.
12. I. Adductor magnus into middle lip of linea aspera, line leading from linea aspera to great trochanter, part of line from linea aspera to inner condyle, and by a tendon into a tubercle upon the inner condyle.
13. I. Quadratus femoris into linea quadrati, or line extending upon posterior margin of great trochanter.
14. I. Glutæus maximus into three inches of line from great trochanter to linea aspera, between the adductor magnus and vastus externus.
15. O. Short head of biceps from linea aspera and line to outer condyle between adductor magnus and vastus externus.
16. I. Adductor longus into linea aspera, middle third of the bone between adductor magnus and vastus internus.
17. I. Adductor brevis into line from lesser trochanter to linea aspera.
18. I. Pectineus in same line in front of adductor brevis.
19. O. Crureus from front of femur, as high as intertrochanteric line, connected with vastus internus.
20. O. Subcrureus from front of femur, lower third.
21. Internal condyle, attaches internal lateral ligament.
22. External condyle, attaches external lateral ligament.
23. O. Popliteus from fossa on outer surface of external condyle.
24. Anterior crucial ligament into external condyle.
25. Posterior crucial ligament into internal condyle.
26. O. Outer head of gastrocnemius and the plantaris from a fossa above external condyle, the latter being external.
27. O. Inner head of gastrocnemius from fossa over inner condyle.

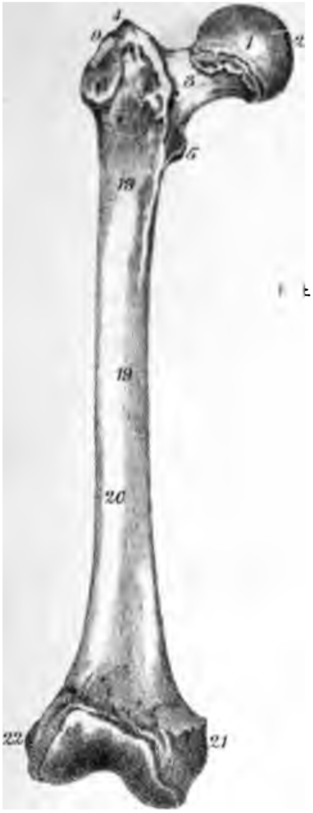
THE TIBIA.

1. Articular surfaces for condyles of femur; circumferences attach the semilunar cartilages.
2. Spine of tibia with fossa in front and behind for anterior and posterior crucial ligaments.
3. Internal tuberosity.
4. External tuberosity.
5. I. Semimembranosus into posterior part of internal tuberosity.
6. Facet for articulation with fibula.
7. Groove for tendon of popliteus.
8. Tubercle of tibia, attaches ligamentum patellæ.
9. Anterior border.
10. Internal border.
11. External border, attaches interosseous membrane.
12. Fossa for attachment of the lower extremity of the fibula.
13. Internal surface, subcutaneous.
14. I. Sartorius, gracilis and semitendinosus.
15. External surface. O. Tibialis anticus, from upper ⅔.
16. Oblique line of tibia. O. Soleus.
17. Triangular surface above oblique line. I. Popliteus.
18. O. Flexor longus digitorum, from about the central half of posterior surface.
19. O. Tibialis posticus, from outer margin of posterior surface.
20. Internal malleolus, attaches internal lateral ligament.
21. Surface for articulation, with astragalus.
22. Anterior ligament of ankle-joint.
23. Internal lateral ligament of ankle.
24. Groove for tendons of tibialis posticus and flexor communis digitorum.

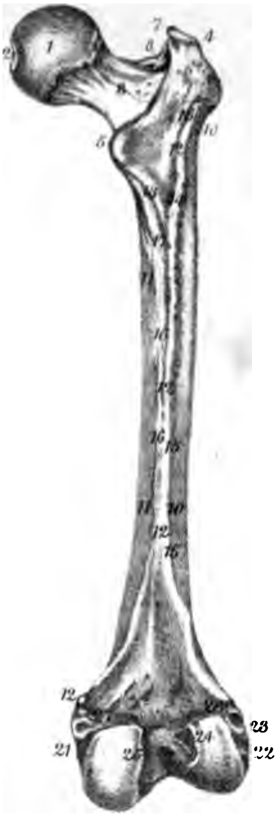
THE FIBULA.

1. Facet for articulation with tibia.
2. Styloid process: apex attaches short external lateral ligament.
3. I. Biceps.
4. Anterior internal or interosseous line.
5. Anterior external border or line.
6. Posterior internal line.
7. Posterior external line.
8. Rough surface for ligamentous attachment with tibia.
9. O. Extensor longus digitorum, from head and upper ¾ of anterior surface.
10. O. Peroneus tertius, from lower fourth of anterior surface, being continuous with previous muscle.
11. Extensor proprius pollicis, from middle ⅓ of anterior surface internal to extensor longus digitorum.
12. O. Peroneus longus and brevis, from outer surface of fibula.
13. O. Soleus, from head and upper fourth of posterior surface.
14. O. Flexor longus pollicis, from the lower ⅔ of posterior surface.
15. O. Tibialis posticus, from the space between the interosseous line and the posterior internal line, which may be called the internal surface of the fibula.
16. Surface for articulation, with astragalus.
17. Groove for tendons of the peroneus longus and brevis.
18. Attachment of middle fasciculus of external lateral ligament.
19. Subcutaneous surface or outer ankle.

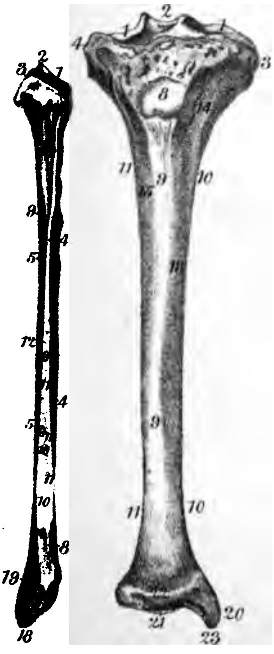
Plate VIII



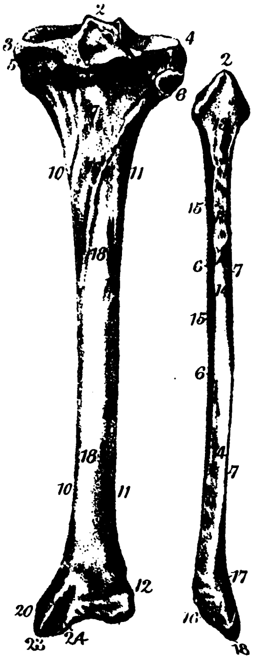
FEMUR



ANTERIOR VIEW



TIBIA & FIBULA



POSTERIOR VIEW

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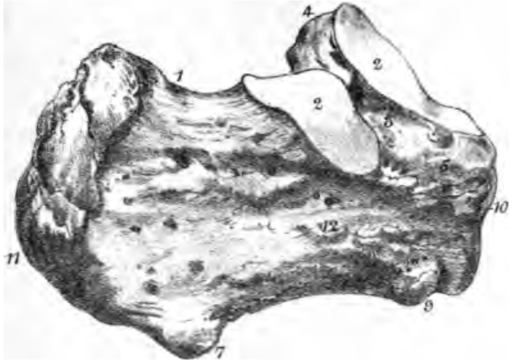
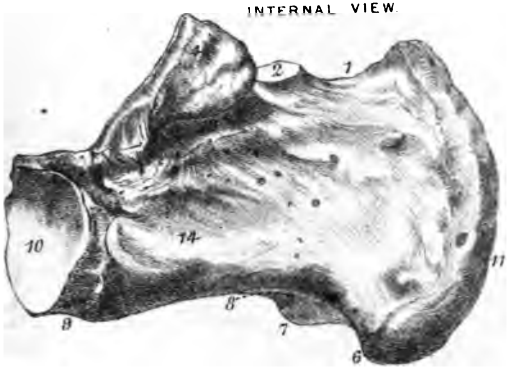
Plate IX.

OS CALCIS

EXTERNAL VIEW

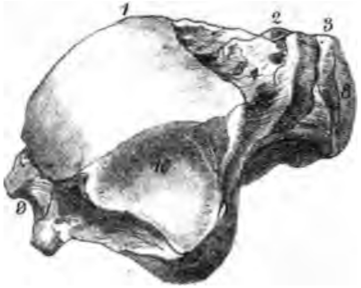


INTERNAL VIEW

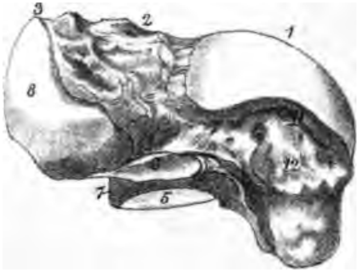


ASTRACALUS

EXTERNAL VIEW

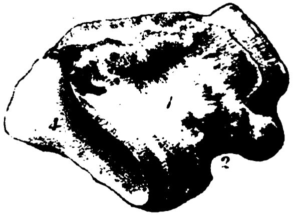


INTERNAL VIEW.



CUBOID

SUPERIOR VIEW.



INFERIOR VIEW.

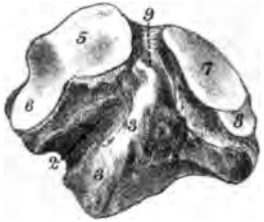


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PLATE IX.

THE TARSUS.

OS CALCIS.

1. Space occupied by fat, &c.
2. Facets for articulation with astragalus.
3. Groove for calcaneo-astragaloid ligament.
4. Sustentaculum tali grooved on its under surface by the flexor longus pollicis.
5. **O.** Extensor brevis digitorum from the upper and outer surface of the anterior extremity of the os calcis.
6. Internal tubercle. **O.** Abductor pollicis and flexor brevis digitorum.
7. External tubercle. **O.** Abductor minimi digiti.
8. Attachment of long plantar or long calcaneo-cuboid ligament to under surface of the os calcis near the tubercles.
9. Short plantar or short calcaneo-cuboid ligament from tubercle at the anterior extremity of the under surface.
10. Anterior surface of os calcis, articulates with the cuboid bone.
11. **I.** Tendo Achillis into lower part of the posterior surface.
12. Attachment of the middle fasciculus of the external lateral ligament of the ankle. In front of this there are often two grooves for the peronei muscles.
13. Groove upon under surface of the sustentaculum tali for flexor longus pollicis.
14. **O.** Flexor accessorius from the inner surface of the os calcis.

ASTRAGALUS.

1. Body.
2. Neck.
3. Head.
4. Rough depression for the anterior fasciculus of the external lateral ligament, and also the anterior ligament of the ankle.
5. Posterior facet, articulates with os calcis.
6. Anterior facet, articulates with os calcis.
7. Groove for astragalo-calcanean ligament.
8. Anterior surface of the head, for articulation with the scaphoid bone.
9. Groove for the tendon of the flexor longus pollicis.
10. External surface, articulates chiefly with the outer malleolus.
11. Facet for articulation with the internal malleolus, generally very small.
12. Attachment of internal lateral ligament.

CUBOID.

1. Dorsal surface.
2. Groove for the tendon of the peroneus longus.
3. Posterior ridge of the peroneal groove and attachment of the long plantar ligament.
4. Posterior surface, articulates with the os calcis.
5. Articular facet on anterior surface for the fourth metatarsal bone.
6. Articular facet on anterior surface for fifth metatarsal bone.
7. Articular facet near the centre of the internal surface for external cuneiform bone.
8. Articular facet upon the posterior part of the internal surface for the scaphoid bone.
9. Rough marking for the interosseous ligament between the cuboid and the external cuneiform bone.

PLATE X.

THE TARSUS.

SCAPHOID.

1. Posterior surface, concave for articulation with astragalus.
2. Portion of the anterior surface for articulation with the internal cuneiform bone.
3. Portion for middle cuneiform bone.
4. Portion for external cuneiform bone.
5. I. Tibialis posticus into the tuberosity of the scaphoid bone.
6. Small facet for articulation with the cuboid bone.
7. Superior or dorsal surface.
8. Inferior or plantar surface.

INTERNAL CUNEIFORM.

1. Posterior surface, articulates with scaphoid bone.
2. Anterior surface, kidney-shaped, articulates with the metatarsal bone of the great toe.
3. Facet of angular form upon outer surface for middle cuneiform bone.
4. Small facet upon the anterior part of the external surface for articulation with the side of the second metatarsal bone.
5. Smooth marking over which the tendon of the tibialis anticus and often a sesamoid bone play.
6. Plantar surface and the base of the wedge which the bone represents. I. Tibialis anticus.

MIDDLE CUNEIFORM

(*is the smallest of the three*).

1. Posterior surface, articulates with the scaphoid bone.
2. Anterior surface, articulates with the second metatarsal bone.
3. Angular facet, the angle being at the upper and posterior corner, upon the inner surface of the bone, for articulation with the internal cuneiform bone.
4. Facet upon outer surface for articulation with the external cuneiform bone.

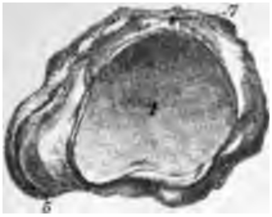
EXTERNAL CUNEIFORM.

1. Posterior surface for articulation with the scaphoid bone.
2. Anterior surface for third metatarsal bone.
3. Facet upon the posterior part of inner surface for the middle cuneiform bone.
4. Small facet upon the anterior part of the inner surface for articulation with the side of the second metatarsal bone.
5. Facet upon the posterior part of outer surface for articulation with the cuboid bone.
6. Small facet upon the anterior part of the external surface for articulation with the side of the fourth metatarsal bone.

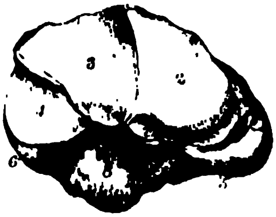
Plate X

SCAPHOID BONE

POSTERIOR VIEW

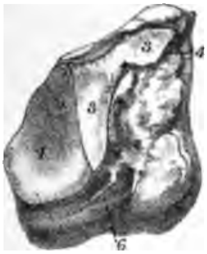


ANTERIOR VIEW

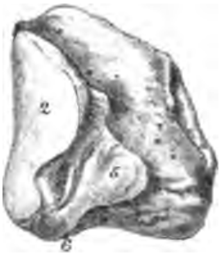


INTERNAL CUNEIFORM

EXTERNAL VIEW

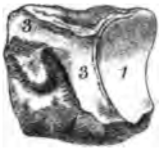


INTERNAL VIEW

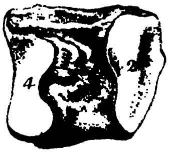


MIDDLE CUNEIFORM.

INTERNAL VIEW

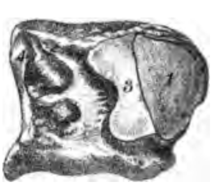


EXTERNAL VIEW



EXTERNAL CUNEIFORM

INTERNAL VIEW



EXTERNAL VIEW

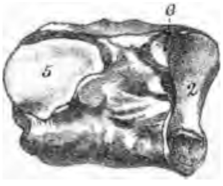


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Plate XI.

THE FOOT

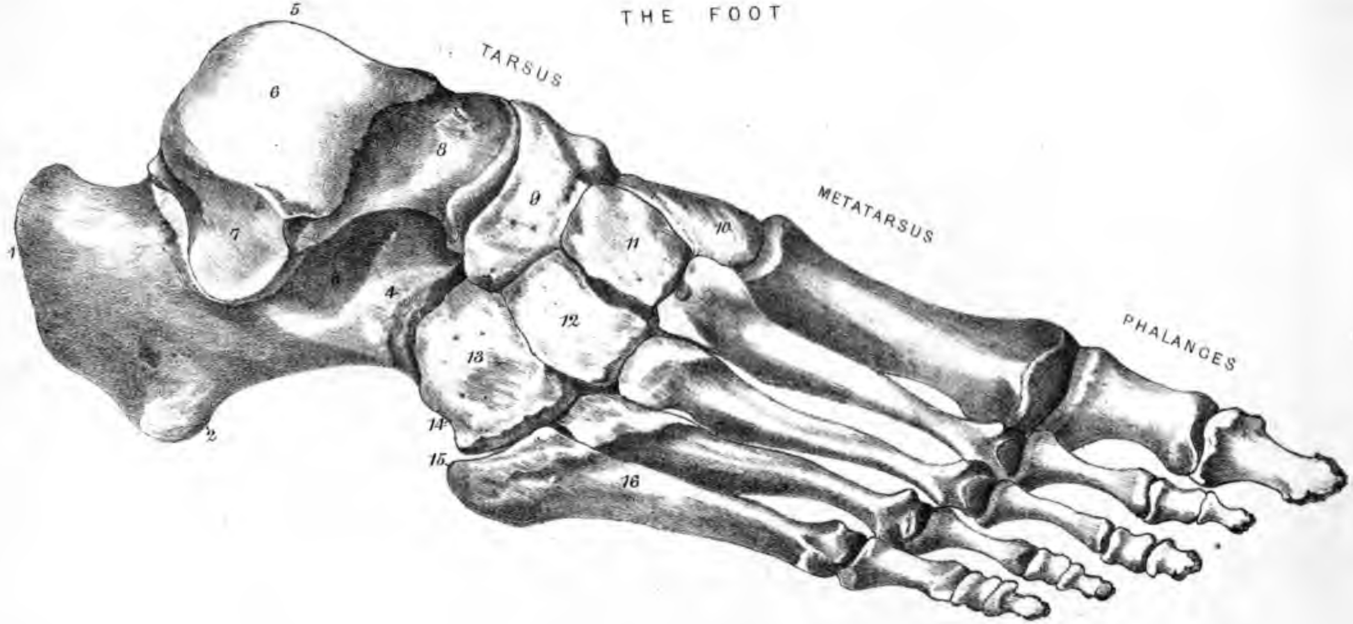


PLATE XI.

THE FOOT.

1. **Os calcis.**
2. **External tubercle. O. abductor minimi digiti.**
3. **Calcaneo-astragaloid groove for the interosseous ligament of same name.**
4. **O. Extensor brevis digitorum, from the upper and outer surface of the anterior extremity of the os calcis.**
5. **Astragalus.**
6. **Surface for articulation with the inferior surface of the lower extremity of the tibia.**
7. **Surface for articulation with the outer malleolus.**
8. **Ligamentous surface.**
9. **Scaphoid.**
10. **Internal cuneiform.**
11. **Middle cuneiform.**
12. **External cuneiform.**
13. **Cuboid.**
14. **Groove for the tendon of the peroneus longus.**
15. **Tuberosity of the fifth metatarsal bone into which is inserted the peroneus brevis.**
16. **I. Peroneus tertius.**

The interosseous muscles arise from the adjacent surfaces of all the metatarsal bones.

PLATE XII.

OCCIPITAL BONE.

1. Internal spine: the point of union of the four ossific points and meeting of the sinuses or torcular Herophili.
2. Longitudinal sinus, the borders of which attach the falx major.
3. Lateral sinus, borders of which attach the tentorium cerebelli.
4. Occipital sinus, borders of which attach the falx cerebelli.
5. Foramen magnum: transmits spinal cord, its membranes and vessels out of the skull, the spinal accessory nerves and vertebral arteries into the skull.
6. Anterior condyloid foramen, through which the ninth nerve leaves the skull.
7. Jugular process. **I.** rectus capitis lateralis.
8. Continuation of the lateral sinus.
9. Jugular fossa, or part of the foramen lacerum posterius.
10. Basilar process.
11. Groove for medulla oblongata and pons Varolii.
12. External spine, attaches ligamentum nuchæ.
13. Superior curved line of the occiput and
14. **O.** Trapezius internally.
15. Occipito frontalis in the centre and
16. **I.** Sterno mastoid externally.
17. Inferior curved line of the occiput,
18. **I.** Rectus capitis posticus minor internally.
19. **I.** Rectus capitis posticus major in the centre.
20. **I.** Obliquus superior externally.
21. **I.** Complexus between the two curved lines.
22. **I.** Splenius capitis between the two curved lines.
23. Condyle.
24. Posterior condyloid foramen, transmits a small vein inwards to the lateral sinus.
25. Attachment of odontoid ligament.
26. Spine of the basilar process and **I.** superior constrictor of pharynx.
27. **I.** Rectus capitis anticus major and minor into fossa at the side of the spine.

28 to 29. Articulates with the parietal bone and forms the lambdoidal suture.

29 to 30. Articulates with the mastoid portion of the temporal bone.

31. Union with the body of the sphenoid bone.

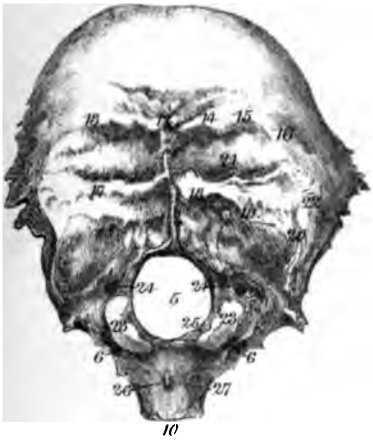
PARIETAL BONE.

1. Grooves for the middle meningeal branches of artery.
2. Half-groove along superior border for superior longitudinal sinus.
3. Fossæ for Pacchionian bodies.
4. Groove on posterior inferior angle for the lateral sinus.
5. Parietal protuberance, the commencing point of ossification.
6. Temporal ridge, the attachment of the temporal aponeurosis.
7. **O.** Temporal muscle from temporal fossa.
8. Superior border, articulates with fellow of opposite side to form the sagittal suture.
9. Anterior border, articulates with frontal bone to form coronal suture.
10. Posterior border, articulates with occipital bone to form the lambdoidal suture.
11. Inferior border, articulates from 11 to 11′ with the mastoid portion of the temporal bone, the remainder with the squamous portion of the temporal bone, except a small portion at the anterior inferior angle, which articulates with the great wing of the sphenoid bone.

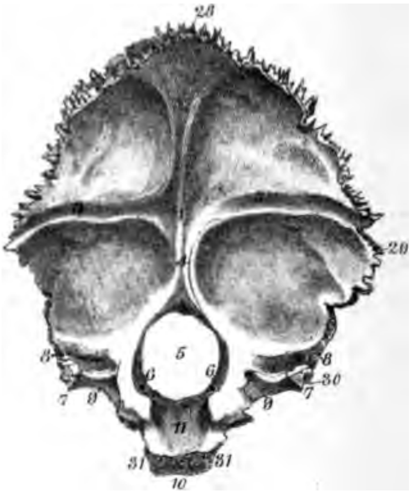
Plate XII.

THE OCCIPITAL BONE.

EXTERNAL VIEW

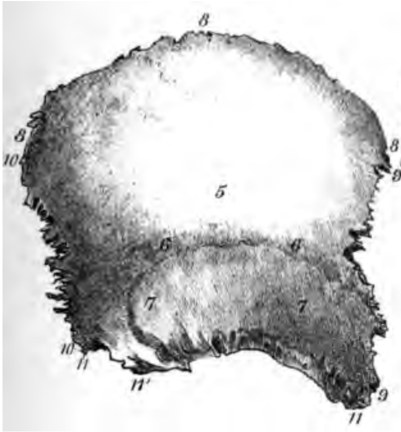


CEREBRAL VIEW

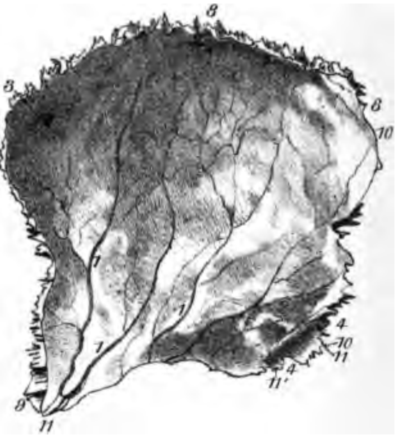


THE PARIETAL BONE.

EXTERNAL VIEW



CEREBRAL VIEW



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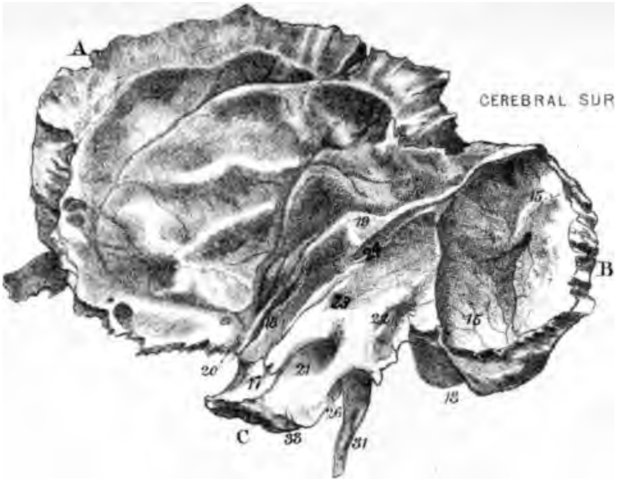
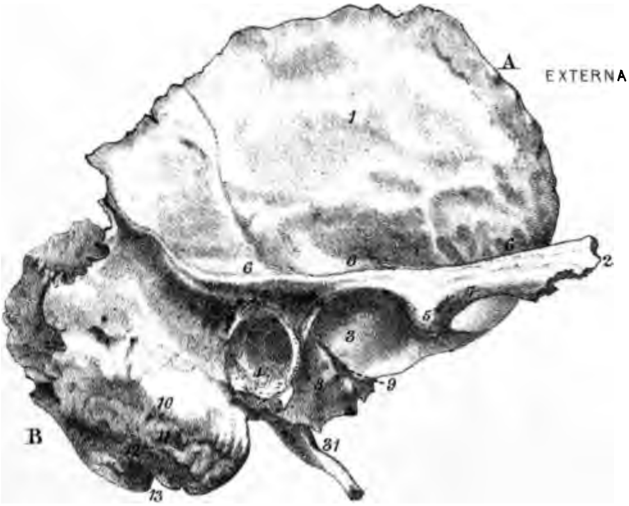
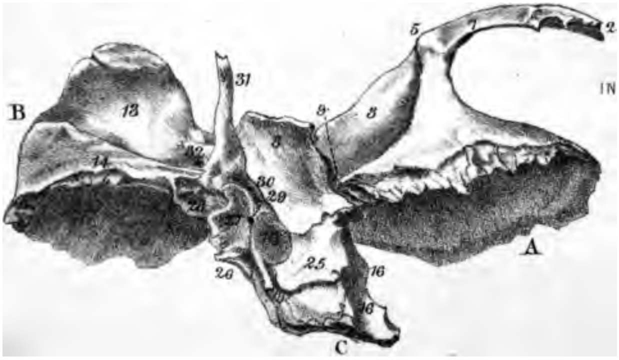
THE TEMPORAL BONE



CEREBRAL SURFACE



EXTERNAL VIEW.



INFERIOR VIEW

[redacted]man del et lith:

PLATE XIII.

THE TEMPORAL BONE.

A. Squamous portion.

B. Mastoid portion.

C. Petrous portion.

1. **O.** Temporal muscle from the temporal fossa.
2. Zygomatic process.
3. Condyloid fossa or glenoid cavity.
4. External auditory meatus.
5. Tubercle upon zygomatic process for attachment of the external lateral ligament of the temporo-maxillary joint.
6. Line attaching the temporal aponeurosis.
7. **O.** Masseter muscle from lower margin of the zygoma.
8. Vaginal or auditory process.
9. Glasserian fissure, transmits chorda tympani nerve, small tympanic vessels, laxator tympani muscle and contains the processus gracilis of the malleus.
10. **I.** Sterno mastoid into outer surface of mastoid portion of the temporal bone.
11. **I.** Splenius capitis immediately below the sterno mastoid.
12. **I.** Trachelo mastoid below splenius.
13. Digastric fossa **O.** posterior belly of the digastric muscle.
14. Groove for the occipital artery.
15. Groove for the lateral sinus.
16. Carotid canal, transmits the carotid artery and filaments of the sympathetic nerve.
17. Depression for Gasserian ganglion of the fifth nerve.
18. Groove leading to hiatus Fallopii and occupied by the Vidian nerve.
19. Elevation due to the superior semicircular canal.
20. Two canals not seen in the diagram: the upper transmits the tensor tympani muscle, the lower is the Eustachian tube.
21. Meatus auditorius internus into which the seventh nerve enters.
22. Aqueductus vestibuli, transmits a small vein.
23. Small depression attaching the dura mater.
24. Groove for superior petrosal sinus, running along the upper margin of the petrous portion outwards to the lateral sinus.
25. Square surface giving origin to levator palati and tensor tympani.
26. Aqueductus cochleæ.
27. Jugular fossa, assists in forming the foramen lacerum posterius.
28. Surface for articulation with the jugular process of the occipital bone.
29. Foramen for Jacobson's nerve.
30. Foramen for Arnold's nerve.
31. Styloid process, it gives origin to stylo-pharyngeus, stylo-hyoid, and stylo-glossus muscles from above downwards, and to the stylo-maxillary and stylo-hyoid ligaments, the latter by its apex.
32. Stylo-mastoid foramen, it transmits the portio dura or facial division of the seventh nerve out of the skull, and is entered by a small stylo-mastoid artery.
33. Inferior petrosal sinus, formed by the junction of the basilar process of the occipital and the petrous portion of the temporal, and running downwards to the jugular foramen or foramen lacerum posterius.

PLATE XIV.

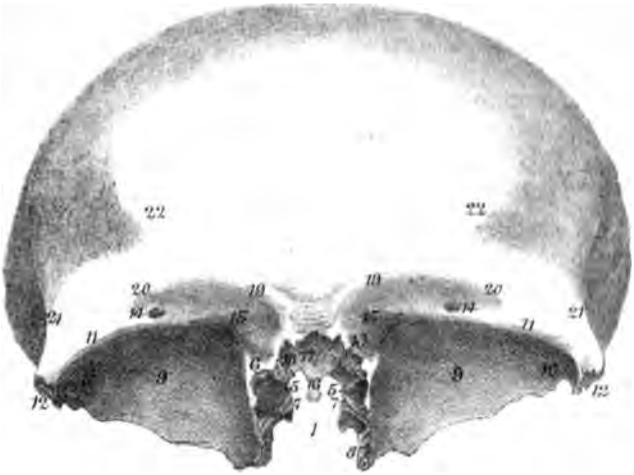
FRONTAL BONE.

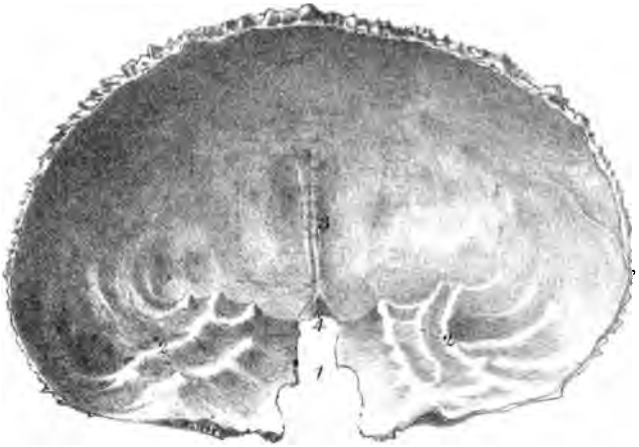
1. Ethmoid space occupied by the ethmoid bone.
2. Anterior cranial fossa.
3. Frontal crest, attaches the falx major, and dividing above into two borders encloses the superior longitudinal sinus.
4. Foramen cæcum, often a small canal transmitting a vein from the nose.
5. Cells completed by the ethmoid bone.
6. Frontal sinus, a space between the tables of the frontal bone, communicating with the middle meatus of the nose.
7. Anterior ethmoidal groove, transmits the naso-lobular nerve of the ophthalmic and a small artery.
8. Posterior ethmoid groove, transmits an anterior meningeal artery from the ophthalmic.
9. Roof of the orbit.
10. Lachrymal fossa for lachrymal gland.
11. Superior orbital ridge.
12. External angular process, articulates with the malar bone.
13. Internal angular process, articulates with the lachrymal bone.
14. Supra-orbital foramen, transmits supra-orbital nerve and artery from ophthalmic.
15. Depression in which is attached the pulley for the tendon of the superior oblique muscle of the eye.
16. Nasal spine of the frontal bone: it articulates with the two nasal bones in front and with the perpendicular plate of the ethmoid behind.
17. Point of articulation with the nasal bones.
18. Point of articulation with the nasal process of the superior maxilla.
19. Elevation due to the frontal sinus.
20. Supraciliary ridge, giving origin at its internal part to the corrugator supercilii muscle.
21. Temporal ridge, extending from the external angular process upwards and backwards: it attaches the temporal aponeurosis.
22. Frontal eminence, the commencing point of ossification.

ETHMOID BONE.

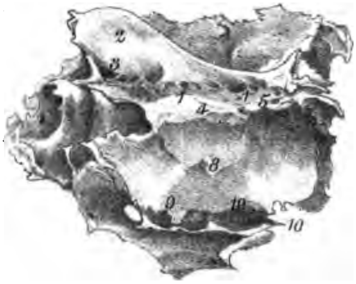
1. Cribriform plate, through which the olfactory nerve-filaments leave the skull.
2. Crista galli, attaches falx major.
3. Nasal fissure, transmits naso-lobular nerve from the skull into the nose.
4. Anterior ethmoidal groove, transmits naso-lobular nerve and small artery from the orbit into the skull.
5. Posterior ethmoidal groove, transmits a small anterior meningeal branch of artery from the orbit into the skull.
6. Vertical plate of the ethmoid.
7. Lateral mass, composed of large ethmoidal cells.
8. Os planum, or orbital plate of the ethmoid bone.
9. Half cells below the os planum, completed by the superior maxilla.
10. Point of articulation with the palate bone.
11. Superior turbinated bone.
12. Superior meatus, into which are seen opening the orifices of the posterior ethmoidal cells. The sphenoidal cells sometimes join the posterior ethmoidal cells and open with them.
13. Middle turbinated bone.
14. Middle meatus: it receives the anterior ethmoidal cells, one of which is joined by the duct from the frontal sinus, and produces a funnel-shaped duct, the infundibulum.
15. A portion of the sphenoidal turbinated bone adherent to the ethmoid.

THE FRONTAL BONE





THE ETHMOID BONE



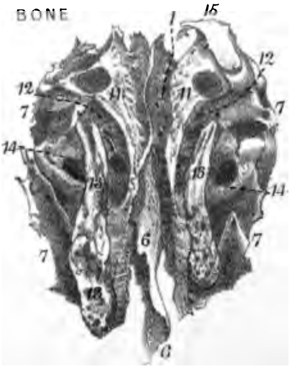
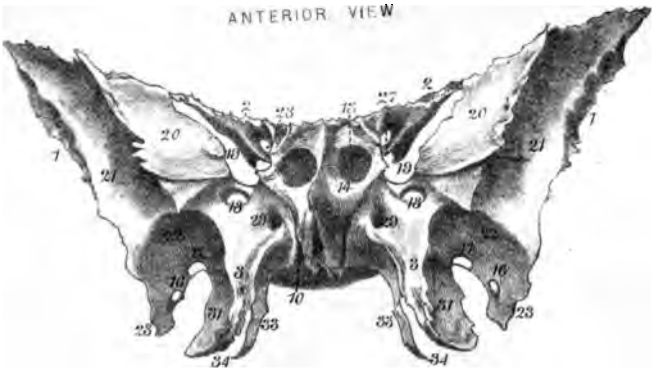


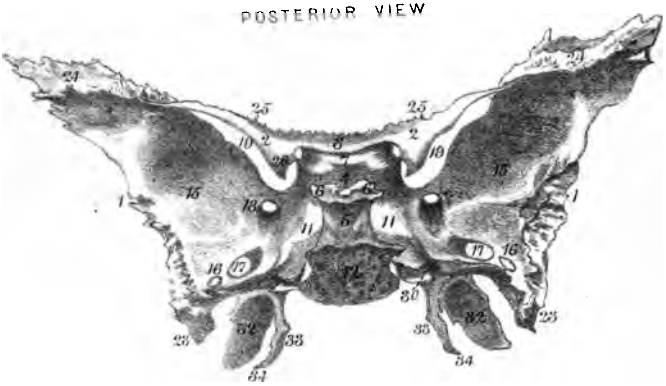
Plate XV

THE SPHENOID BONE

ANTERIOR VIEW

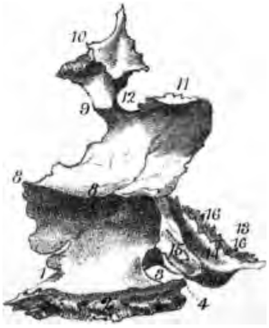


POSTERIOR VIEW



THE PALATE BONE

INTERNAL VIEW



INFERIOR VIEW

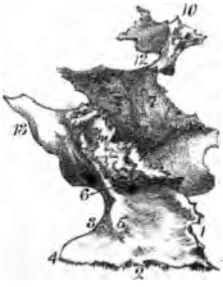


PLATE XV.

SPHENOID BONE.

1. Great wing.
2. Lesser wing, attached by two roots.
3. Pterygoid process.
4. Pituitary fossa, receives the pituitary gland or body.
5. Dorsum Ephippii.
6. Posterior clinoid processes, attach the tentorium cerebelli.
7. Olivary process upon which the optic commissure lies.
8. A portion of the superior surface of the body in front of the olivary process.
9. Rostrum, articulates with alæ of the vomer.
10. Pterygo-palatine canal, transmits pterygopalatine vessels and nerve.
11. Groove in which lie the cavernous sinus and the internal carotid artery.
12. Posterior surface, articulates with the basilar process of the occiput.
13. Sphenoid cells.
14. Sphenoidal turbinated bone.
15. Cerebral surface of great wing.
16. Foramen spinosum, transmits middle meningeal artery into skull.
17. Foramen ovale, transmits inferior maxillary nerve, or third division of fifth, out of the skull, and a small artery, the meningea-parva, into the skull.
18. Foramen rotundum, through which the superior maxillary nerve, or second division of fifth, leaves the skull.
19. Foramen lacerum anterius, or sphenoidal fissure, through which the third, fourth, ophthalmic (first division of fifth) and sixth nerves pass from the skull into the orbit, and the ophthalmic vein returns.
20. Orbital surface of great wing, quadrilateral in form, contributes to outer wall of orbit.
21. External surface of great wing, its upper portion belongs to temporal fossa, and gives origin to temporal muscle.
22. External surface of great wing, its lower portion belongs to zygomatic fossa, and gives origin to the external pterygoid muscle.
23. Spine of the sphenoid, attaches internal lateral ligament of lower jaw and O. laxator tympani muscle.
24. Triangular surface for articulation with the frontal bone.
25. Line of articulation of the lesser wing with the ethmoid bone.
26. Anterior clinoid process, attaches tentorium cerebelli.
27. Lower root of lesser wing.
28. Optic foramen, transmits the optic nerve and ophthalmic artery. Around the front of this foramen the muscles of the eye arise.
29. Anterior orifice of Vidian canal, transmits Vidian nerve and artery.
30. Posterior orifice of Vidian canal.
31. External surface of external pterygoid plate and O. external pterygoid muscle.
32. Internal surface of external pterygoid plate and O. internal pterygoid muscle.
33. Internal pterygoid plate, at the base of which an elliptical depression, the scaphoid fossa, gives origin to the tensor palati muscle.
34. Hamular process, around which the tensor palati muscle turns.

PALATE BONE.

1. Anterior border of horizontal plate, articulates with the palatine process of superior maxilla.
2. Internal border, articulates with fellow.
3. Posterior border.
4. Posterior nasal spine.
5. Transverse ridge. I. tensor palati.
6. Posterior palatine canals, transmit posterior palatine vessels and nerves.
7. External surface of vertical plate of the palate bone, articulates with superior maxilla.
8. Inferior turbinated ridge for inferior spongy bone.
9. Middle turbinated ridge for middle spongy bone.
10. Orbital process, presents five surfaces; anterior articulates with superior maxilla; posterior articulates with sphenoidal turbinated; internal articulates with ethmoid; superior contributes to orbital fossa; external contributes to spheno-maxillary fossa.
11. Sphenoidal process articulates superiorly with body of the sphenoid: inferiorly contributes to nares; externally contributes in part to the spheno-maxillary fossa, and in part overlaps the internal pterygoid plate.
12. Spheno-palatine notch or foramen transmits spheno-palatine vessels and nerves into the nose.
13. Tuberosity of the palate bone.
14. Groove contributing to pterygoid fossa.
15. Groove for internal pterygoid plate.
16. Rough margin for external pterygoid plate.

PLATE XVI.

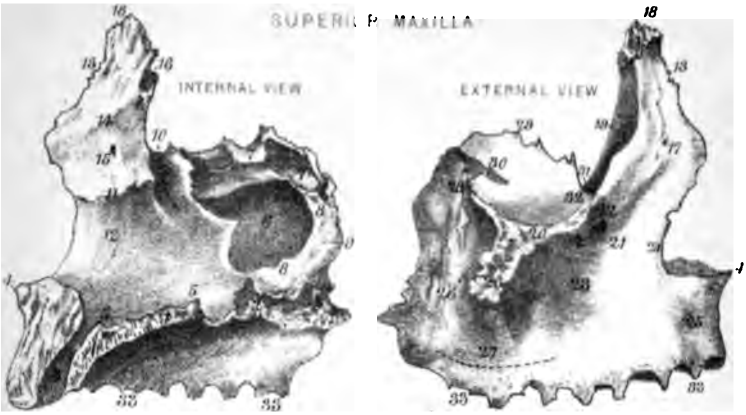
SUPERIOR MAXILLA.

1. Palatine process, articulates with fellow by its internal border and with horizontal plate of palate bone by its posterior border.
2. Space completed by horizontal plate of the palate bone.
3. Naso-palatine canal, transmits naso-palatine vessels and nerve.
4. Anterior nasal spine.
5. Crest for the reception of the vomer.
6. Antrum of Highmore.
7. Half cells completed by palate and ethmoid bones.
8. Surface for articulation with perpendicular plate of the palate bone.
9. Groove completed as a canal by palate bone for posterior palatine vessels and nerves.
10. Groove for lachrymal canal.
11. Turbinated crest, articulates with inferior spongy bone.
12. Outer wall of inferior meatus.
13. Nasal process of the superior maxilla.
14. Crest for articulation with middle spongy bone.
15. Outer wall of middle meatus.
16. Cell completed by ethmoid bone.
17. External surface of the nasal process and O. levator labii superioris alæque nasi.
18. Apex of nasal process, articulates with frontal bone.
19. Posterior internal border, articulates with lachrymal bone.
20. Articulation with malar bone.
21. Infra-orbital foramen, transmits infra-orbital vessels and nerve, branches of the superior maxillary nerve and internal maxillary artery.
22. O. Levator labii superioris, from the surface above the infra-orbital foramen.
23. Canine fossa. O. levator anguli oris.
24. O. Compressor naris.
25. Myrtiform fossa and O. depressor alæ nasi.
26. Zygomatic surface.
27. O. Buccinator muscle, from outer surface of alveolar border, as far forward as the three molar teeth.
28. Margin of the orbital plate which bounds the spheno-maxillary fissure.
29. Internal margin of the orbital plate, articulates with three bones—lachrymal in front, os planum of ethmoid, and at the posterior angle with the orbital process of the plate bone.
30. Infra-orbital canal traversing the orbital surface.
31. The orbital orifice of the lachrymal canal.
32. O. Inferior oblique muscle of the eye, from the inner angle of the floor of the orbit.
33. Alveolar border, with spaces for the roots of eight teeth.

INFERIOR MAXILLA.

1. Symphysis of lower jaw.
2. Mental fossa. O. levator menti.
3. Mental foramen, transmits mental nerve and artery, branches of the inferior dental.
4. External oblique line, below which I. platysma myoides.
5. O. Depressor labii inferioris.
6. O. Depressor anguli oris.
7. O. Buccinator, as far forward as the three molar teeth.
8. Symphysis (internal view).
9. Tubercular elevation, sometimes presenting four tubercles, of which the upper two give origin to the two genio-hyoglossus muscles and the lower to the two genio-hyoid.
10. Depression for O. anterior belly of the digastric.
11. Sublingual fossa, the position of the sublingual gland.
12. Internal oblique line, or mylo-hyoid ridge. O. mylo-hyoid muscle.
13. O. Superior constrictor of pharynx, from the posterior part of the mylo-hyoid ridge.
14. Submaxillary fossa, position of the submaxillary gland.
15. I. Masseter upon the outer surface of the ramus.
16. Groove for the facial artery situated at the anterior border of the masseter muscle.
17. Inferior dental canal, transmits inferior dental vessels and nerve to the teeth.
18. Mylo-hyoid groove traversed by the mylo-hyoid vessels and nerve.
19. Vaginal process, attaches internal lateral ligament of lower jaw.
20. I. Pterygoideus internus into inner surface of the ramus.
21. Attachment of the stylo-maxillary ligament into the posterior margin and angle of the ramus.
22. Condyle of the lower jaw.
23. I. Pterygoideus externus into depression in front of the neck of the condyle.
24. Coronoid process.
25. I. Temporal muscle into inner surface of coronoid process.
26. Sigmoid notch through which the masseteric vessels and nerve pass outwards to the muscle.

Plate XVI


SUPERIOR MAXILLA
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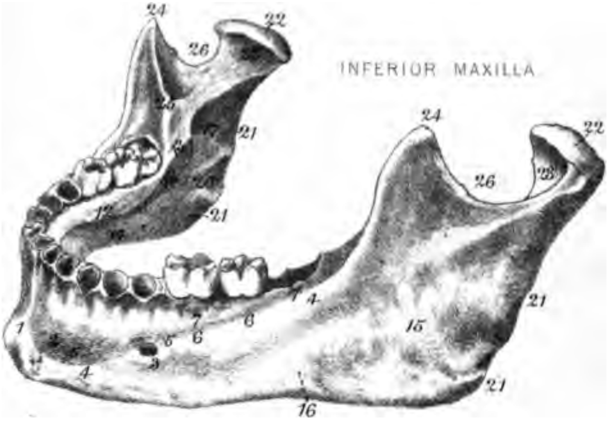
INFERIOR MAXILLA
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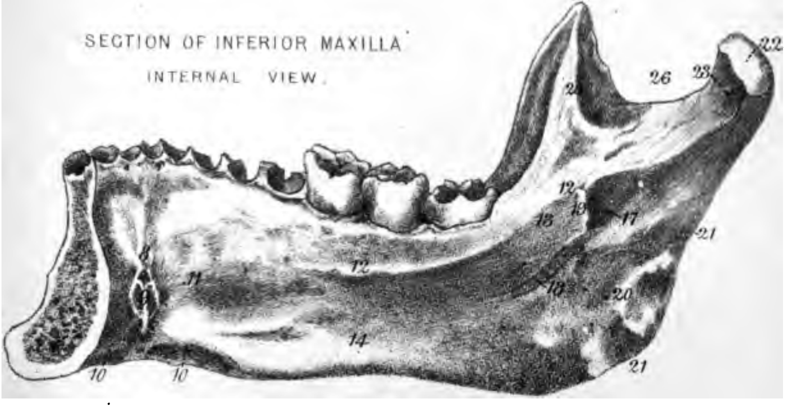
SECTION OF INFERIOR MAXILLA
INTERNAL VIEW
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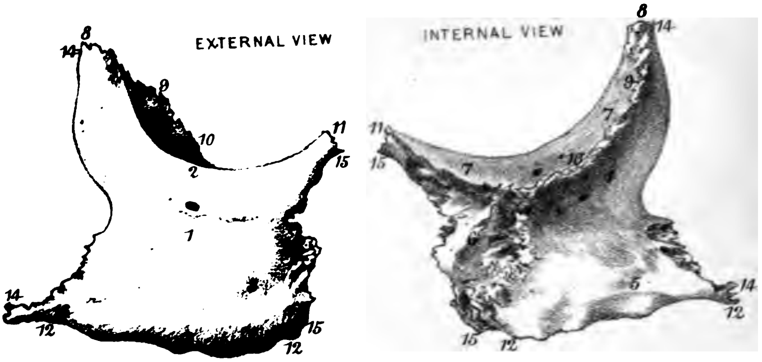
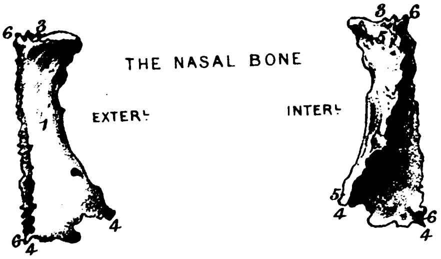
Plate XVII.

THE MALAR BONE


EXTERNAL VIEW

INTERNAL VIEW

THE NASAL BONE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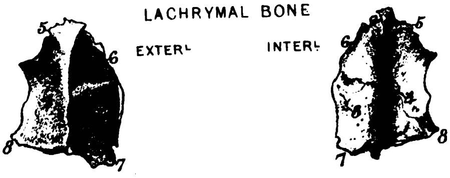
LACHRYMAL BONE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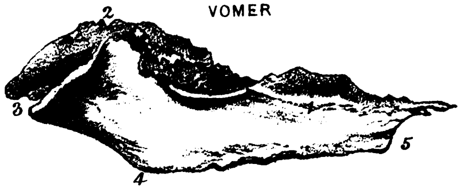


INFERIOR TURBINATED

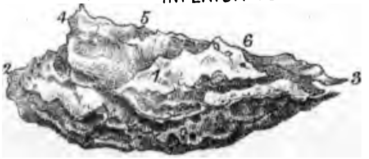


PLATE XVII.

MALAR BONE.

1. External surface.

2. I. Some fibres of the orbicularis palpebrarum, but a large portion of the muscle extends some distance over the external surface.

3. O. Zygomaticus major and zygomaticus minor, the latter being superior in position when present.

4. Part of the internal aspect above the zygomatic process, contributing to the temporal fossa and O. temporal muscle.

5. Part contributing to the zygomatic fossa.

6. Rough surface for articulation with the malar process of the superior maxilla.

7. Orbital border from which the orbital plate extends backwards to form part of the floor and outer wall of the orbit.

8 to 9. Margin which articulates with the frontal bone.

9 to 10. Articulates with the orbital plate of the sphenoid bone.

10 to 11. Articulates with the orbital plate of the superior maxillary bone.

12. Inferior or zygomatic border.

13. O. Some anterior fibres of the masseter muscle.

14. Posterior or temporal border, of which the upper part attaches the temporal aponeurosis, and the lower rough part articulates with zygomatic process of the temporal bone.

15. Anterior or maxillary border articulates with the superior maxillary bone.

NASAL BONE.

1. Anterior or external surface covered by the pyramidalis nasi.

2. Posterior surface contributes to the roof of the nose.

3. Superior border articulates with the rough notch in the frontal bone.

4. Inferior border, connected with the lateral cartilage of the nose.

5. Internal or anterior border, very thick above, articulates with its fellow.

6. External or posterior border, articulates with the anterior border of the nasal process of the superior maxillary bone.

LACHRYMAL BONE.

1. Anterior portion of the external surface, is in the form of a groove, and assists in forming the lachrymal canal.

2. Posterior portion of the external surface contributes to the inner wall of the orbit.

3. Anterior portion of internal surface contributes to the middle meatus of the nose.

4. Posterior portion of internal surface overlaps the ethmoid bone.

5 to 6. Superior border, articulates with frontal bone.

6 to 7. Anterior border, articulates with the nasal process of the superior maxillary bone.

7 to 8. Inferior border, articulates with the inferior turbinated in front and behind with the orbital plate of the superior maxilla.

5 to 8. Posterior border, articulates with the os planum of the ethmoid.

VOMER.

1. Groove for the naso-palatine nerve.

2 to 3. Superior border and expanding alæ, which embrace the rostrum of the sphenoid bone.

4 to 5. Inferior border; it is received into a groove formed by the union of the two palatine processes of the superior maxilla, and the two horizontal plates of the palate bone.

3 to 4. Posterior border, the separation of the two posterior nares.

2 to 5. Anterior border, articulates with the perpendicular plate of the ethmoid.

INFERIOR TURBINATED, OR SPONGY BONE.

1. Internal surface.

2. Anterior extremity, rounded.

3. Posterior extremity, pointed.

2 to 4. That part of the superior border which articulates with the inferior crest of the superior maxilla.

4. An ascending process, articulates with the lachrymal bone, and immediately behind this process the border is in contact with the lateral mass of the ethmoid bone.

5 to 6. From this part a lamina curves over, outwards and downwards, to assist in forming the inner wall of the antrum of Highmore.

6 to 3. Articulates with the lower ridge upon the perpendicular plate of the palate bone.

The inferior margin of the inferior spongy bone is free within the nose.

PLATE XVIII.

THE BASE OF THE SKULL.

INFERIOR VIEW.

1. Roof of the mouth.
2. Anterior palatine canal, transmits same vessels and nerve.
3. Posterior palatine foramen, transmits same vessels and nerves.
4. Posterior orifice of the nares.
5. Internal pterygoid plate with the hamular process curving from its apex.
6. External pterygoid plate. O. external and internal pterygoid muscles.
7. Foramen ovale, transmits arteria meningea parva into the skull, third division of fifth nerve out of skull.
8. Foramen spinosum (arteria meningea media into the skull).
9. Spine of sphenoid, attaches internal lateral ligament of lower jaw and O. laxator tympani muscle.
10. Basilar process. I. superior constrictor of pharynx into a central tubercle, and rectus capitis anticus major and minor upon each side.
11. Foramen lacerum medium.
12. O. Levator palati and tensor tympani, from square surface upon under surface of the petrous portion of temporal bone.
13. Carotid canal for carotid artery.
14. Foramen lacerum posterius, transmits the jugular vein and the three trunks of the eighth nerve.
15. Aqueductus cochleæ.
16. Foramen for Jacobson's nerve.
17. Vaginal process.
18. Stylo-mastoid foramen, transmits the portio dura of the seventh nerve and a stylo-mastoid artery.
19. Digastric fossa. O. posterior belly of digastric.
20. Glasserian fissure, transmits chorda tympani nerve, laxator tympani muscle, tympanic artery, and contains the processus gracilis of the malleus.
21. Glenoid cavity—anterior part for temporo-maxillary articulation, posterior part occupied by a process of the parotid gland.
22. Foramen magnum (spinal cord and its membranes and vessels out of skull, vertebral arteries and spinal accessory nerves into skull).
23. Condyle of the occiput.
24. Anterior condyloid foramen, transmits ninth nerve.
25. Posterior condyloid foramen, transmits a small vein inwards to lateral sinus.
26. Jugular process. I. rectus capitis lateralis.
27. Inferior curved line. I. rectus capitis posticus minor internally, major in the centre, and superior oblique externally.
28. Superior curved line. O. trapezius internally, occipito frontalis in the centre, and I. sterno mastoid externally.
29. I. Complexus between the two curved lines.
30. I. Spleneus capitis between the two curved lines external to the complexus.

CEREBRAL VIEW

(Three Fossæ).

ANTERIOR FOSSA.

1. Crista galli, attaches falx major.
2. Foramen cæcum.
3. Cribriform plate, perforated for the filaments of the olfactory nerve.
4. Nasal fissure for naso-lobular nerve.
5. Ethmoid foramina—anterior transmits the naso-lobular nerve from the orbit into the skull; posterior a small anterior meningeal artery.
6. Anterior clinoid process, attaches tentorium cerebelli.

MIDDLE FOSSA.

7. Pituitary fossa.
8. Dorsum Ephippii, the superior angles of which are termed the posterior clinoid processes, and attach the tentorium cerebelli.
9. Olivary process grooved above by the optic commissure.
10. Groove for cavernous sinus and for the internal carotid artery.
11. Foramen lacerum anterius or sphenoidal fissure, transmits the third, fourth, first division of fifth, and the sixth nerve into the orbit, and the ophthalmic vein back into the skull.
12. Foramen rotundum, transmits the second division of the fifth nerve.
13. Foramen ovale (third division of fifth nerve and small meningeal artery).
14. Foramen spinosum, transmits the middle meningeal artery into skull.
15. Foramen lacerum medium, occupied by a fibro cartilage.
16. Groove upon the anterior surface of the petrous portion of the temporal bone, traversed by the Vidian nerve, and enters the bone at the hiatus Fallopii.
17. Fossa for Gasserian ganglion.
18. Prominence of the superior semicircular canal.

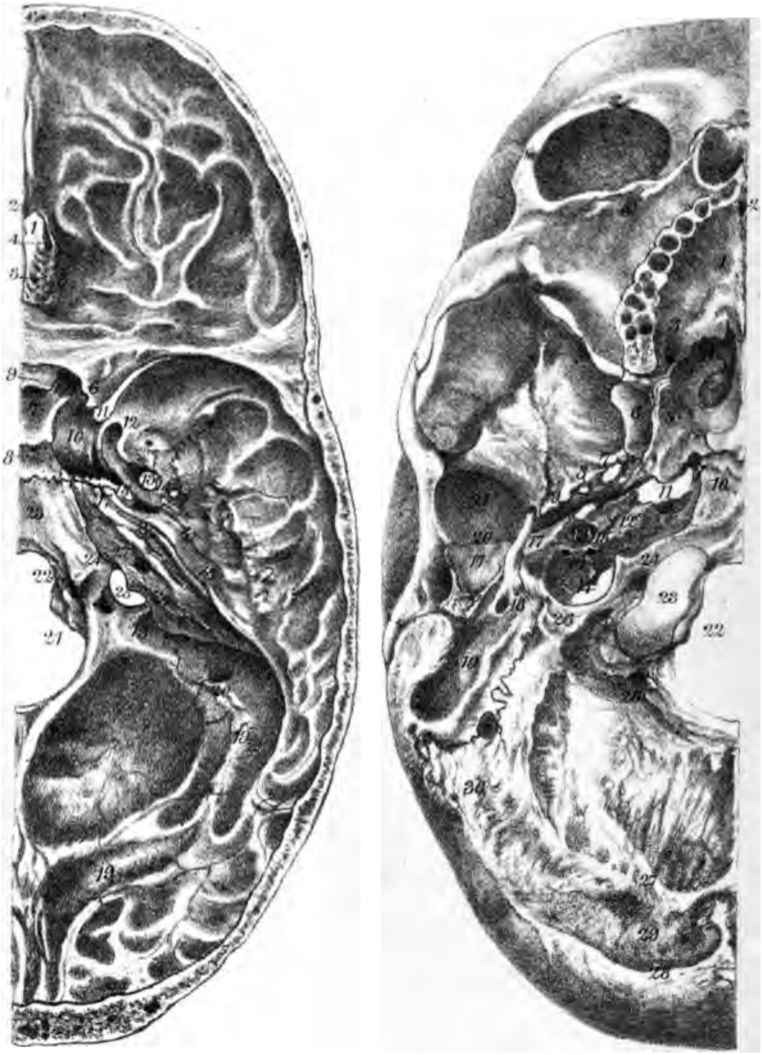
POSTERIOR FOSSA.

19. Groove for lateral sinus—borders attach tentorium cerebelli.
20. Mastoid foramen—vein entering lateral sinus.
21. Foramen magnum.
22. Anterior condyloid foramen (hypoglossal or ninth nerve).
23. Basilar process grooved for medulla.
24. Groove for inferior petrosal sinus.
25. Foramen lacerum posterius or jugular foramen.
26. Groove for superior petrosal sinus.
27. Meatus auditorius internus, transmits the portio mollis and portio dura of the seventh nerve.
28. Aqueductus vestibuli, transmits a small vein.

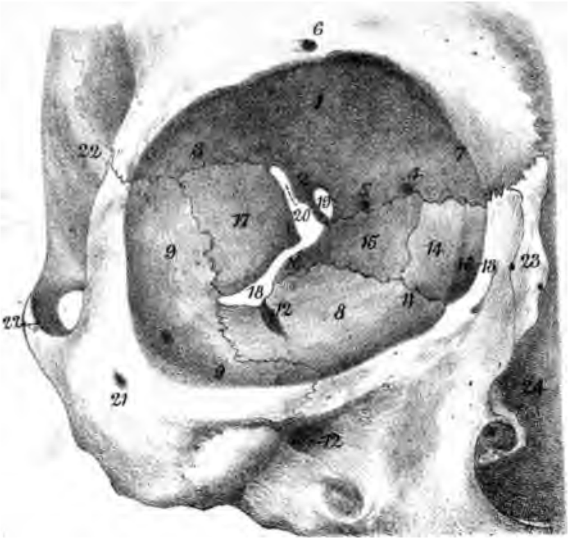
THE BASE OF THE SKULL

CEREBRAL VIEW

INFERIOR VIEW



THE ORBITAL FOSSA



THE NASAL FOSSA

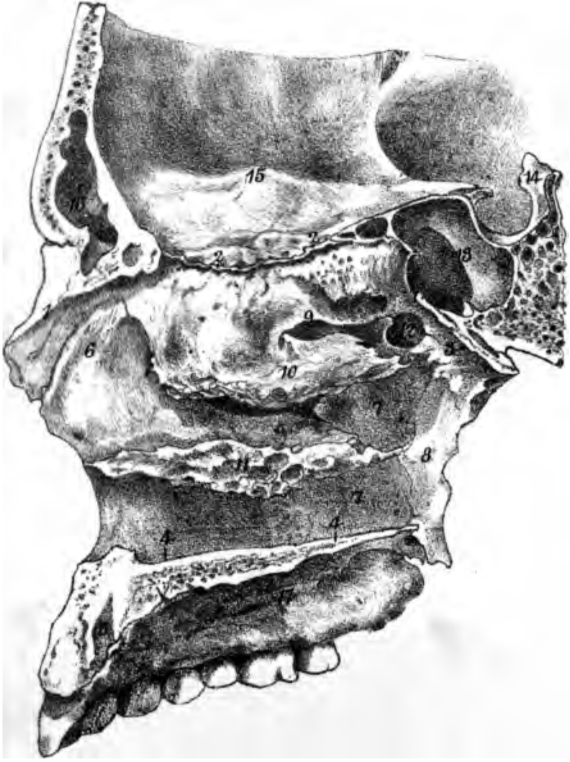


PLATE XIX.

ORBITAL FOSSA.

1 Orbital plate of the frontal bone, forming the chief part of the roof of the orbit.

2. Lesser wing of the sphenoid bone.

3. Fossa in the outer angle of the roof of the orbit for the lachrymal gland.

4. Anterior ethmoidal foramen transmits naso-lobular branch of ophthalmic nerve.

5. Posterior ethmoidal foramen, transmits an anterior meningeal artery from ophthalmic.

6. Supra orbital foramen transmits supra orbital nerve and artery from the orbit to the forehead.

7. Depression in which is attached the cartilaginous pulley for the superior oblique muscle of the eye.

8. Orbital plate of the superior maxilla, forms the chief part of the floor of the orbit.

9. Orbital plate of the malar bone, contributes to the outer wall and to the floor.

10. Orbital process of the palate bone, contributes slightly to the floor.

11. O. Inferior oblique from the superior maxilla close to the canal for the lachrymal sac.

12. Infra orbital canal, transmits infra orbital nerve from superior maxillary nerve and infra orbital artery from internal maxillary.

13. Nasal process of the superior maxilla.

14. Lachrymal bone, inner wall of orbit.

15. Orbital plate of the ethmoid, contributes to inner wall.

16. Lachrymal canal.

17. Orbital plate of sphenoid, forms the chief part of the outer wall.

18. Spheno-maxillary fissure connecting the orbit with the zygomatic and spheno-maxillary fossæ.

19. Optic foramen, transmits optic nerve and ophthalmic artery into orbit: around it the muscles of the eye arise.

20. Foramen lacerum anterius or sphenoidal fissure, transmits third, fourth, first division of fifth, and the sixth nerves into the orbit, and the ophthalmic vein, into the skull.

21. Malar bone.

22. Zygomatic process, above which is the temporal fossa and origin of the temporal muscle.

23. Nasal bone.

24. Cavity of the nose.

NASAL FOSSA.

1. Nasal bone.

2. Cribriform plate of ethmoid through which the filaments of the olfactory nerve pass into the nose.

3. Lower surface of the body of the sphenoid, with the ala of the vomer and sphenoidal process of the palate bone uniting.

4. Floor of the nose formed by the palatine process of the superior maxilla, and the horizontal plate of the palate bone.

5. Naso-palatine canal, transmits the naso-palatine or anterior palatine nerve and vessels.

The internal wall of the nose is not seen in the plate. It is composed of the elevated internal margin of the palatine process of the superior maxilla, and of the horizontal plate of the palate bone; the perpendicular plate of the ethmoid bone; and the spine of the frontal bone.

The external wall of the nose is formed by—

6. Nasal process of the superior maxilla;

Nasal surface of lachrymal bone;
Cellular mass of ethmoid; } not seen, being hidden by the turbinated bone.

7. Perpendicular plate of palate bone.

8. Internal pterygoid plate. Connected with the outer wall are the turbinated bones overlapping the meatus or sinus of the nose.

9. Superior spongy or turbinated bone, overlapping the superior meatus, into which the posterior ethmoidal cells open, and from the outer side the spheno-palatine foramen.

10. Middle turbinated bone, overlapping the middle meatus, into which open the anterior ethmoidal cells; infundibulum or duct of the frontal sinus uniting with one of the anterior ethmoidal cells; and the orifice of the antrum of Highmore.

11. Inferior turbinated bone, overlapping the inferior meatus, into which the lachrymal canal opens.

12. Spheno-palatine foramen transmitting the spheno-palatine vessels and nerve.

13. Sphenoidal cells.

14. Dorsum Ephippii.

15. Cerebral surface of the orbital plate of the frontal bone.

16. Frontal sinus.

17. Roof of mouth.

PLATE XX.

THE ORGAN OF HEARING.

The osseous part of the organ of hearing is composed of the external auditory canal, middle ear or tympanum, and internal ear or labyrinth.

The external auditory canal extends from the outer orifice to the membrana tympani.

The middle ear, or tympanum, is six-sided, about half-an-inch in length, and a quarter in breadth. Roof corresponds to a portion of the anterior surface of the petrous portion of the temporal bone. Floor is, in position, immediately over the jugular fossa. External wall (*see* plate) presents :—

1. Membrana tympani.
2. Glasserian fissure in front of the membrana, through which the laxator tympani muscle and small tympanic artery enter, in which also the processus gracilis of the malleus is attached, and parallel with which runs a fine canal for the exit of the chorda tympani nerve.

In contact with the external wall are the ossicula of the ear.

3. Body of the incus.
4. Its short crus.
5. Long crus of the incus.
6. Stapes.
7. Head of malleus.
8. Manubrium of malleus.
9. Processus gracilis of malleus.
10. Processus obtusus of malleus.
11. Mastoid cells.

Internal wall seen in the plate at the depths of the external auditory canal by the removal of the membrana tympani.

1. Aqueductus Fallopii, passage of the portio dura of the seventh nerve, it projects upon the inner wall, but in the plate the surface is removed to expose the open canal.
2. Foramen ovale, orifice into the vestibule: it receives the base of the stapes.
3. The promontory, a prominent surface due to the position of the first turn of the cochlea.
4. Foramen rotundum, a round orifice opening beneath the promontory into the cochlea (its scala tympani).

Posterior wall presents orifices leading into mastoid cells, and a conical elevation termed the pyramid, hollow, and containing the origin of the stapedius muscle.

Anterior wall or extremity of the tympanum, contracts to form two parallel canals, separated from each other by a fine lamina, the processus cochleoriformis: the upper canal transmits the tensor tympani muscle and the lower is the Eustachian tube.

Within the tympanum are three small bones, the ossicula.

Malleus :—

1. Head articulates with incus.
2. Neck.
3. Manubrium lies between the layers of the membrana tympani.
4. Processus gracilis, attached within the Glasserian fissure.
5. Processus brevis, extends upwards and outwards, and receives the insertion of the tensor tympani.

Incus :—

1. Facet upon body for articulation with the head of the malleus.
2. Short crus, attached to the mastoid cells.
3. Long crus, parallel with but behind the manubrium: it articulates with the stapes, a small bone, the
4. Os orbiculare, intervening.

Stapes :—

1. Head articulates with os orbiculare.
2. Base, flat and oval, fits into the foramen ovale.
3. Anterior crus, the shorter.
4. Posterior or long crus.

LABYRINTH.

1. Vestibule, composed of two fossæ, one at the anterior and inferior part. The upper is called fossa hemi-elliptica, and the lower fossa hemi-spherica. Posterior wall of vestibule receives the five orifices of the semicircular canals. On the inner wall at the lower pari are the orifices for the filaments of the portio mollis of the seventh nerve, and also the orifice of a canal, the aqueductus vestibuli. On outer wall is fenestra ovalis, leading into tympanum. In anterior wall, at lower part, is the orifice leading to scala vestibuli of the cochlea.
2. Semicircular canals, two vertical and one horizontal. Each is dilated at one extremity, the ampulla, and the two vertical unite together at their non-ampullary extremities, so that only five orifices open into the vestibule.
3. Cochlea is a tube making two and a-half turns around a central axis (1) the modiolus. The tube is divided into two smaller tubes, termed scalæ, by a thin plate, the (2) lamina spiralis. The two scalæ unite at the apex of the cochlea, which is termed the (3) cupola, but at the base they open one into the vestibule, the scala vestibuli, and the other into the tympanum, the scala tympani. In the scala tympani, near its entrance into the tympanum, is a small orifice, the aqueductus cochleæ.
4. Meatus auditorius internus, situated near the base of the cochlea.
5. Aqueductus vestibuli.

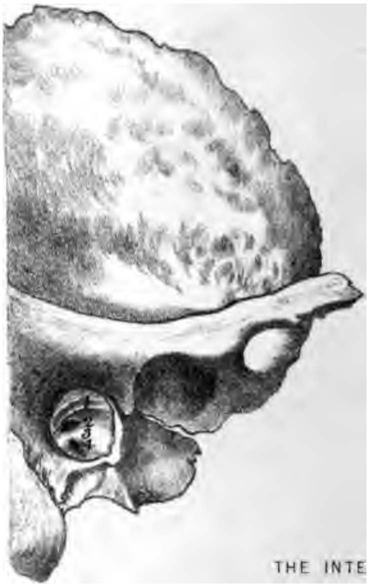
DIAGRAM OF COCHLEA.

1. Modiolus.
2. Lamina spiralis.
3. Cupola.

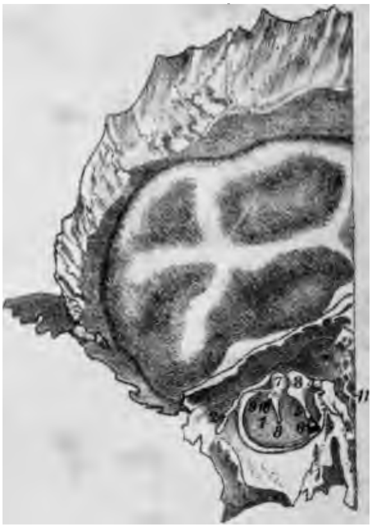
Plate XX.

THE ORGAN OF HEARING.

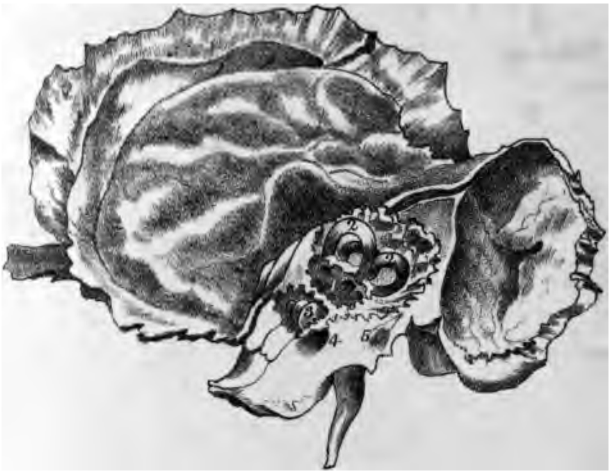
INTERNAL WALL OF THE TYMPANUM



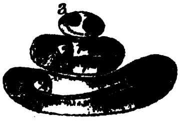
EXTERNAL WALL OF THE TYMPANUM



THE INTERNAL EAR
COMPONENT PARTS IN SITU



COCHLEA



MALLEUS

INCUS

STAPES

J. S. Coleman, del: et lith: Harrison & Sons, imp.